JPRS-USP-86-005

12 SEPTEMBER 1986

USSR Report

SPACE

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USSR REPORT

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CONTENTS

INTERPLANETARY SCIENCES

COMMENTARY, DIAGRAM OF 'MIR' STATION

Moscow MOSCOW NEWS in English No 20, 25 May-1 Jun 86 p 10

[Article by Mikhail Chernyshov: "Coastal Navigation in Space"]

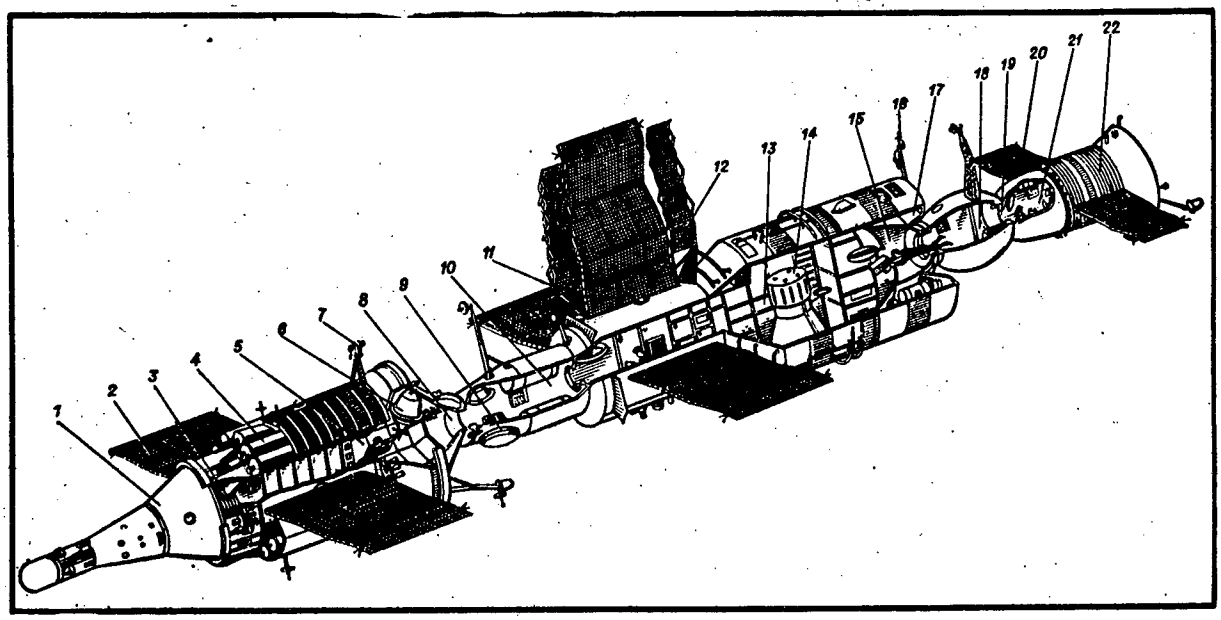
[Text] For the first time ever in the history of space exploration, a crew working at an orbital station (Mir) has flown to another orbital station (Salyut-7) some 3,100 km away. The flight was performed by cosmonauts Leonid Kizim and Vladimir Solovyov.

"The experiment is interesting from a purely technical point of view, if only because with it we started to master, figuratively speaking, the methods of coastal navigation in space," says Viktor Blagov, deputy mission commander. "To date three separate installations have been involved in it--Mir, the Soyuz T-15 manned spaceship and Salyut-7, but in principle more can be used.

"Maybe in the future, space workers will have to assemble large structures in orbit. Such projects are needed, for example, for building the antennas of radiotelescopes and of electric fields which transform solar radiation into electric power that is delivered to orbital production enterprises. It is possible that the assembly of the structures will be done from several base platforms and, in the course of the assembly, cosmonauts will have to fly from one platform to another. Such tasks, however, are still quite a long way off. But in the near future the need might arise to change the base when working on the existing orbital complexes. What does this involve?

"The current situation with the orbital stations is a bit of a paradox. We are 'breaking in' the new Mir station, which has six docking points. This provides the opportunity for the assembly in orbit of quite an important 'grape' of specialized modules docked to the stations. However, we are well aware of the fact that it is unprofitable, from many points of view, to keep constantly in orbit any kind of docked cumbersome mass. This sort of a conglomerate loses altitude rather quickly, due to atmospheric drag, however weak it is. Lifting orbit calls for considerable fuel expenditures. Besides that, each of the modules needs its own orientation and its own conditions for functioning. It is practically impossible to blend this in a single, docked

ORBITAL SPACE COMPLEX: COSMOS SPUTNIK-SHIP – SALYUT 7 STATION – SOYUZ TRANSPORT SHIP.



Cosmos sputnik-ship:

1. re-entry vehicle; 2. solar battery; 3. transfer tunnel; 4. fuel tank; 5. operational-service unit; 6. inner transfer hatch; 7. antenna of the radio-technical docking system; 8. docking unit.

Salyut 7 station:

9. hatch for going out to space; 10. transfer compartment; 11. additional solar battery; 12. main solar battery; 13. working compartment; 14. research instruments compartment; 15. transfer module; 16. antenna of radio-technical docking; 17. engine compartment.

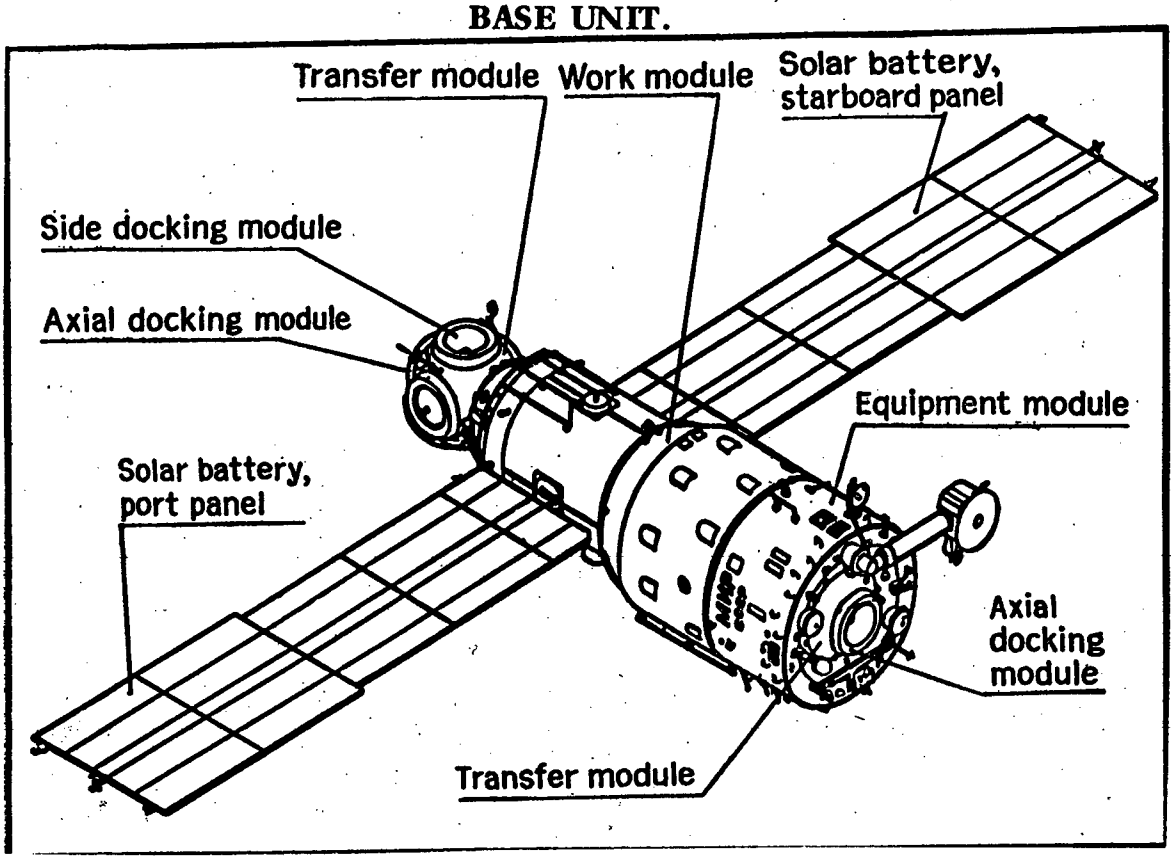
Soyuz transport ship:

18. living compartment; 19. hatch for transfer to living compartment; 20. solar battery; 21. descent capsule; 22. instrument compartment.

complex. It seems more rational to organize the work of the complex in such a manner, when some of the modules are operating in a docked state, while others are flying autonomously nearby. It is at this point that it may be necessary for the crew to fly from the central base-station to the autonomous modules for servicing them, taking away ready produce and overhauling them.

"There are a number of reasons, besides the general circumstances cited above, due to which the flight by Kizim and Solovyov from Mir to Salyut-7 had been planned. The main task of the crew when the Soyuz T-15 started in March this year was to check up the new station's ability to function, and to prepare it completely to receive modules. The cosmonauts transferred on March 15 from the spaceship to the station and started to carry out this part of the programme. There was quite a lot of technical work to be done. In particular, a new system of communications with the mission control centre, through the special Luch sputnik, is being used in the Mir station. The cosmonauts spent quite a lot of time putting the channels of this system into order. Mir has not

THE MIR ORBITAL RESEARCH STATION.
BASE UNIT.



one on-board computer, as previous stations, but seven. They are aimed at considerably saving the crew's time on the station. Kizim and Solovyov initially had their work cut out testing the computers in different conditions. Lastly, two Progress freight ships were sent to Mir in the six weeks of the station's manned flight. Part of their cargo is intended for Mir, but a number of instruments and elements of equipment are to be used on Salyut-7.

"The flight to Salyut-7 was performed with the aid of three consecutive manoeuvres. First of all, the Soyuz T-15 spaceship was separated by spring-operated pushers from Mir. The ship moved away to a considerable distance from the station but the engines were not switched on at this stage, so as not to mar the glass of the optical instruments of Mir with exhaust fumes. The same methods tested by Dzhanibekov and Savinykh in their flight were later on used by the cosmonauts for the ship's search and approach to Salyut-7."

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CSO: 1852/3

FEATURES OF 'MIR' STATION SOLAR PANELS, CONTROL SYSTEMS

Moscow EKONOMICHESKAYA GAZETA in Russian No 12, Mar 86 p 24

[Article by B. Fedorov]

[Excerpt] The new scientific research spacecraft which bears the sonorous and symbolic name "Mir" can rightly be classed as a multipurpose space laboratory of the third generation, since it represents a qualitatively new stage in manned technology.

The five docking mechanisms on the station's adapter module are an interesting and novel aspect of this spacecraft. They are perhaps the principal basic difference between the "Mir" and its predecessors.

The "Mir" has still other differences. The station's solar panels are different. There are three such panels on "Salyut-7" and two on the "Mir." The new station's power-to-weight ratio is substantially larger, however. How was this done? The area of the station's solar batteries was increased from 51 to 76 square meters, and the efficiency of their solar-radiation converters was heightened by installing new types of solar cells, particularly ones made of gallium arsenide. This made it possible to increase the space power plant's capacity substantially.

"Fundamental changes pertain to all of the vitally important systems of the station," emphasized Doctor of Technical Sciences K.P. Feoktistov, one of the developers of the space laboratory.

Incorporated in the "Mir" are many technical achievements of recent years in the fields of radioelectronics and automation. The new station was designed on the basis of new components, using semiconductor integrated circuits and miniature electronic devices.

The movement control system on the orbiting station is perhaps one of its most complex and critically important systems. The "Mir" is equipped with an electronic brain whose nucleus is an onboard digital computer complex assembled on the basis of integrated circuits. This electronic brain orients the station

in space quickly and with high precision and maintains stabilized flight in the orbital system of coordinates for as long as is wished. This promises great advantages for the cosmonauts, by freeing them of routine work.

One unquestionable advantage of the electronic brain which must be noted is the possibility of displaying, on the screens of video terminals, information on the operation of control systems. These terminals are installed in a central station. Output of information which the crew needs on the course of this or that dynamic operation is not the only good thing about this innovation. Pictures are transmitted from the screens to the Control Center, where specialists have the opportunity of monitoring and analyzing the situation on a real time scale, so to speak.

FTD/SNAP
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CSO: 1866/139

TASS REPORTS TESTS OF 'MIR' SYSTEMS

Moscow IZVESTIYA in Russian 4 May 86 p 12

[Text] Flight Control Center, 3 March. As of 1600 hours today, Moscow time, the orbiting station "Mir" had completed 185 revolutions around the Earth.

In line with the program schedule, tests of the station's systems and apparatus are continuing. Specifically, last week checks were performed of the functioning of the power-supply and heat-regulating systems in various modes of flight, and tests were conducted with the computer complex and the radiotechnical equipment for docking.

According to telemetry results, all systems of the "Mir" station are functioning normally. Control of its flight is being accomplished through commands from Earth and with the aid of onboard automation.

FTD/SNAP
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CSO: 1866/139

TASS REPORTS 'SOYUZ T-15' SPACECRAFT, CREW READY FOR LAUNCH

Moscow KRASNAYA ZVEZDA in Russian 13 Mar 86 p 1

[Text] Flight Control Center, 12 March. The pre-launch training of the cosmonaut crew consisting of Leonid Kizim and Vladimir Solovyev is ending at the Baykonur Cosmodrome. The launch of the spaceship "Soyuz T-15" is planned for 13 March.

Baykonur Cosmodrome, 12 March. Preparations for the launch of the spaceship "Soyuz T-15" are ending. The spaceship and its rocket have been taken to the launching pad.

Members of the crews that have undergone training for this space mission arrived at the cosmodrome on 3 March. They have made final size measurements inside the spaceship and have completed medical examinations. Heads of services reported on readiness for the launch at a meeting of the State Commission which took place today. The members of the crew that will man the spaceship were named. They are Leonid Kizim and Vladimir Solovyev, who took part in a 237-day mission on board the orbiting station "Salyut-7."

The launch is set for 13 March, at 1533 hours, Moscow time.

(A photograph is given showing the crew's commander, USSR pilot-cosmonaut L.D. Kizim, and the flight engineer, USSR pilot-cosmonaut V.A. Solovyev, during a visit to Red Square.)

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CSO: 1866/139

TASS REPORTS LAUNCH OF 'SOYUZ T-15'

Moscow PRAVDA in Russian 14 Mar 86 p 1

[TASS Report]

[Text] In line with the program of research of outer space, a spaceship, "Soyuz T-15," was launched from the Soviet Union on 13 March 1986, at 1533 hours, Moscow time. The spaceship is piloted by a crew consisting of the ship's commander, Colonel Leonid Denisovich Kizim, USSR pilot-cosmonaut and twice Hero of the Soviet Union; and the flight engineer, USSR pilot-cosmonaut Vladimir Alekseyevich Solovyev, Hero of the Soviet Union.

The flight program calls for docking the "Soyuz T-15" ship with the scientific station "Mir," which was placed into a near-Earth orbit on 20 February 1986, and for the crew to carry out planned scientific-technical research and experiments on board the station. The docking of the spacecraft is planned for 15 March.

According to telemetry information, the "Soyuz T-15" ship's onboard systems are functioning normally.

Cosmonauts Leonid Kizim and Vladimir Solovyev are feeling well.

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BIOGRAPHICAL DATA ON 'SOYUZ T-15' COSMONAUTS

Moscow PRAVDA in Russian 14 Mar 86 p 1

[Text] USSR pilot-cosmonaut Leonid Denisovich Kizim, twice Hero of the Soviet Union, was born on 5 August 1941, in the city of Krasnyy Liman, Donetsk Oblast.

He graduated from the Chernigov Higher Military Aviation School for Pilots in 1963. He subsequently served in the Air Force. He has the qualifications "Military pilot, first class" and "Test-pilot, third class."

Leonid Denisovich was enrolled in the contingent of cosmonauts in 1965.

L.D. Kizim has been a member of the Communist Party of the Soviet Union since 1966.

In 1975, without leaving his main work, Leonid Denisovich graduated from the Air Force Academy imeni Gagarin.

L.D. Kizim has made two space flights. He made the first one in 1980 as commander of the spaceship "Soyuz T-3" and the orbiting station "Salyut-6," and the second flight, which lasted 237 days, in 1984 as commander of the spaceship "Soyuz T-10" and the orbiting station "Salyut-7."

USSR pilot-cosmonaut Vladimir Alekseyevich Solovyev, Hero of the Soviet Union, was born in Moscow on 11 November 1946.

After graduating from the Moscow Higher Technical School imeni Bauman in 1970, he worked in a design bureau, where he took part in the development of new models of space technology.

V.A. Solovyev has been a member of the Communist Party of the Soviet Union since 1977.

Vladimir Alekseyevich was enrolled in the contingent of cosmonauts in 1978.

Vladimir Alekseyevich made his first space flight, which lasted 237 days, in 1984 as flight engineer of the spaceship "Soyuz T-10" and the orbiting station "Salyut-7."

(Photographs of Kizim and Solovyev are given.)

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CSO: 1866/139

TASS REPORTS COSMONAUTS PREPARE FOR DOCKING

Moscow PRAVDA in Russian 15 Mar 86 p 1

[TASS Report]

[Text] Flight Control Center, 14 March. The spaceship "Soyuz T-15," which is piloted by the crew consisting of Leonid Kizim and Vladimir Solovyev, had completed 14 revolutions around the Earth as of 1200 hours Moscow time.

In accordance with the designated flight program, the cosmonauts have performed routine operations for checking the airtightness of the spaceship's compartments and monitoring its onboard systems, and they have carried out a correction of the spaceship's orbit.

Today the crew will continue preparations for docking with the scientific station "Mir." One more maneuver for the long-distance approach to the station will be executed for this purpose, during the second half of the day.

According to results of trajectory measurements, the "Soyuz T-15" ship's orbit parameters at the present time are: maximum distance from the Earth's surface--298 kilometers; minimum distance from the Earth's surface--240 kilometers; period of revolution--89.7 minutes; inclination--51.6 degrees.

The flight is proceeding normally. The condition of the health of Leonid Kizim and Vladimir Solovyev is good, and they are feeling well.

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CSO: 1866/139

COMMENTS ON 'SOYUZ T-15' FLIGHT ROUTE, FLIGHT CONTROL

Moscow PRAVDA in Russian 15 Mar 86 p 6

[Article by A. Pokrovskiy, special correspondent at the Flight Control Center]

[Excerpt] The Soviet television hook-up from Baykonur to the Flight Control Center via Ostankino made us more than just witnesses of the direct report on the space launch of Leonid Kizim and Vladimir Solovyev. It was like a hookup to a different time as well. After all, the launching pad which we saw on our TV screens on 13 March was the very one from which Yuriy Gagarin left on his triumphant flight almost a quarter of a century ago.

I said to USSR pilot-cosmonaut Aleksey Arkhipovich Leonov, deputy head of the Cosmonaut Training Center: "The time spent on the ground by the 'Mayaki' [the crew of "Soyuz T-15"] turned out to be comparatively short. Leonid Kizim and Vladimir Solovyev took off in 'Soyuz T-10' in February of 1984 and flew for 237 days on 'Salyut-7', and now comes a new launch."

"Revisions in the training of crews were necessitated, of course, by the previous expedition's return ahead of schedule, because of Vasyutin's illness," said A. Leonov. "And in these conditions, specialists were unanimously of the opinion that the experienced, hard-working and friendly Kizim and Solovyev were the best-prepared for the present flight."

The route charted for them this time is not quite the usual one for manned spaceships; it is one which is more often used in flights of cargo ships. In such cases, the time that elapses from launch to docking is not the usual 26 hours but about two days. On the other hand, this longer route proves to be more economical, in keeping with the laws of celestial mechanics. It never hurts to have a little fuel in reserve.

The first two-pulse approach maneuver was carried out by the end of the first day of flight. "Soyuz T-15" was getting closer and closer to the station "Mir."

"What else is distinctive about this flight?" said deputy flight director V. Blagov, repeating a question. "From our point of view, it is the fact that the controllers have had to be divided into four groups: one for controlling the 'Mir' station, one for controlling 'Soyuz T-15', one for

controlling the 'Salyut-7' station, and one in charge of preparations for launches of cargo spaceships, which have now become an integral part of space complexes. The work load is thus a considerable one, you see. The 'Soyuz' and 'Mir' are now the principal objects of attention, of course; after all, they are to dock by the evening of 15 March."

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TASS REPORTS DOCKING OF 'SOYUZ T-15' WITH 'MIR' STATION

Moscow IZVESTIYA in Russian 17 Mar 86 p 1

[TASS Report]

[Text] The spaceship "Soyuz T-15" docked with the orbiting scientific station "Mir" on 15 March 1986, at 1638 hours Moscow time. After checking the seal of the docking mechanism, cosmonauts Leonid Kizim and Vladimir Solovyev went inside the station.

The crew's flight program calls for activating the "Mir" station, testing structural elements and onboard systems of the station, and adjusting and tuning units and apparatus. This work will be done for the purpose of preparing the station to serve as a base block for creating, in the future, a permanently operating manned complex with specialized modules for scientific and economic purposes.

According to telemetry information, the onboard systems of the "Mir" station and the "Soyuz T-15" spaceship are functioning normally.

Two orbiting complexes are now flying in near-Earth space: "Mir"--"Soyuz T-15," which is operating in the manned mode, and "Salyut-7"--"Cosmos-1686," which is operating in the automatic mode.

The conditions of the health of comrades Kizim and Solovyev is good, and they are feeling well.

Flight Control Center, 16 March. The manned complex "Mir"--"Soyuz T-15" is functioning for the second day in near-Earth orbit.

In accordance with the designated program, cosmonauts Leonid Kizim and Vladimir Solovyev are performing operations for putting the station into the manned-flight mode. In particular, they are activating life-support and temperature-control systems and checking the functioning of radar equipment and the condition of other equipment and apparatus.

Conditions close to terrestrial ones are being maintained in the "Mir" station's living compartments: temperature--24 degrees Celsius; pressure--860 millimeters of mercury.

According to telemetry information and the crew's reports, the flight of the manned complex "Mir"--"Soyuz T-15" is proceeding normally. The complex's orbit parameters at the present time are: maximum distance from the Earth's surface--354 kilometers; minimum distance from the Earth's surface--332 kilometers; period of revolution--91.2 minutes; inclination--51.6 degrees.

Cosmonauts Leonid Kizim and Vladimir Solovyev are healthy and feeling well.

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DETAILS OF 'SOYUZ T-15' DOCKING MANEUVER

Moscow TRUD in Russian 16 Mar 86 p 1

[Article by B. Golovachev, special correspondent at the Flight Control Center]

[Excerpt] This time, the "Soyuz T-15" spaceship was scheduled to dock with the orbiting station "Mir" not within 24 hours of its launch, as has usually been the case in the past, but within two days. Why?

"Primarily to save fuel," said Professor K.P. Feoktistov, in answer to my question. "Fuel consumption is lower on both the spaceship and the station when such a rendezvousing plan is used."

Efficient consumption of fuel (or 'working medium', to use the more correct term) is important on any space flight, but it was particularly important on this one. A number of complex maneuvers in orbit had to be executed by Leonid Kizim and Vladimir Solovyev in the "Soyuz T-15" ship. Docking with the station "Mir" was accomplished yesterday in line with an unusual plan and necessitated additional consumption of working medium. What was this plan? The spaceship approached "Mir" from the direction of the docking mechanism which is located on the station's stern. Rendezvousing proceeded automatically, under the supervision of the cosmonauts. Approaching the docking mechanism quite closely, the crew took over control of the spaceship, braked it, and put it into the hovering mode.

The flight program of "Soyuz T-15" called for docking the ship at another mechanism of the station--the forward one, which is equipped with a promising new radar docking system. This system is designed for automatic docking of modules which will augment the station in the future. "Soyuz T-15" could not dock there in the automatic mode, however. It is the last spaceship of its series. The ships that follow it will have a new docking system. The present crew therefore had to dock manually with the station, on the side of its forward mechanism.

"Soyuz T-15" thus hovered, in line with the program; on a command from the Earth, the "Mir" station began to turn around slowly, so that it would occupy a position in space which would be convenient for a fly-around by the spaceship, under the prevailing conditions of illumination. The "Mir" completed

its turn in a little over five minutes and hung motionless at a distance of about 50-70 meters from "Soyuz T-15." A few minutes later, the crew began the fly-around and rendezvousing with the station.

The schedule called for docking to take place at 1650 hours. At 1638 hours, however, when the cosmonauts were over the Atlantic in the region of the equator, a report was received from them:

"Contact made!"

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COMMENTS ON 'SOYUZ T-15' COSMONAUTS' TRAINING

Moscow IZVESTIYA in Russian 17 Mar 86 p 2

[Article by A. Ivakhnov, special correspondent at the Flight Control Center]

[Abstract] The article reports on activities at the Flight Control Center during the rendezvousing and docking of the spaceship "Soyuz T-15" with the orbiting station "Mir."

Background is provided on training which the spaceship's crew--cosmonauts Leonid Kizim and Vladimir Solovyev--underwent in preparation for this mission. Training in procedure for docking the ship with the orbiting station was a main part of their preflight program, it is recalled. It is explained that the automation equipment of "Soyuz T-15" would operate only during the stage of rendezvousing with "Mir"; operations for the docking of the two spacecraft would have to be performed manually by the crew. In the course of their training, Kizim and Solovyev rehearsed these operations dozens of times, using a training simulator at the cosmodrome. They received assistance from V. Dzhanibekov and V. Savinykh, who had followed approximately the same procedure in approaching the station "Salyut-7" in 1985.

It is related that during the flight of "Soyuz T-15," interaction between the radio systems of the spaceship and "Mir" could begin when the ship was approximately 20 kilometers from the station. Rendezvous proceeded in the automatic mode until the ship was 200 meters from the station. The ship did not dock at the station's equipment compartment because sunlight made this difficult; instead, a variant procedure proposed by ballistics experts was followed, in which "Soyuz T-15" flew around "Mir" while the station rotated so that a different docking mechanism was turned in the direction of the ship. Docking began after Kizim reported to flight director V. Ryumin that this mechanism was properly positioned in relation to the spaceship.

After the cosmonauts had gone inside the station, USSR pilot-cosmonaut Aleksandr Pavlovich Aleksandrov, a member of the back-up crew of "Soyuz T-15," praised the skill and the speed with which Kizim and Solovyev handled these operations. He noted that the whole docking process was completed in record time--less than 20 minutes.

A photograph is given showing Kizim and Solovyev inside the "Mir" station.

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TASS REPORTS COSMONAUTS CONTINUE ACTIVATION OF 'MIR' STATION

Moscow PRAVDA in Russian 19 Mar 86 p 1

[TASS Report]

[Text] Flight Control Center, 18 March. As of 1300 hours Moscow time, the orbiting scientific station "Mir" had completed 420 revolutions around the Earth. Leonid Kizim and Vladimir Solovyev are working on board this station.

The cosmonauts are continuing planned operations for activating equipment and apparatus of the station. The system for regenerating water from atmospheric moisture has been put into operating condition by the cosmonauts, and they have tested radio and television communications apparatus and activated life-support and temperature-control systems.

In line with the designated flight program, today is a day of rest on board the orbiting complex.

According to a conclusion of physicians of the flight's medical support group, Leonid Kizim and Vladimir Solovyev are undergoing the process of adaptation to zero gravity well.

According to the crew's reports and telemetry data, the onboard systems of the manned complex "Mir"--"Soyuz T-15" are functioning normally.

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CSO: 1866/139

TASS REPORTS LAUNCH OF 'PROGRESS-25'

Moscow PRAVDA in Russian 20 Mar 86 p 1

[TASS Report]

[Text] In accordance with the program for ensuring the further functioning of the orbiting scientific station "Mir," an automatic cargo spaceship, "Progress-25," was launched from the Soviet Union on 19 March 1986, at 1308 hours Moscow time.

The spaceship was launched for the purpose of delivering materials which are subject to depletion and various cargo items to the orbiting station.

The "Progress-25" spaceship was placed into an orbit with the parameters: maximum distance from the Earth's surface--268 kilometers; minimum distance from the Earth's surface--189 kilometers; period of revolution--88.8 minutes; inclination--51.6 degrees.

According to telemetry data, the onboard systems of the automatic cargo ship are functioning normally.

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COMMENT ON COMPUTER ASSISTANCE TO COSMONAUTS

Moscow IZVESTIYA in Russian 21 Mar 86 p 3

[Article by A. Ivakhnov, special correspondent at the Flight Control Center]

[Excerpt] Leonid Kizim and Vladimir Solovyev are receiving much assistance from electronics. Their entire flight program is stored in the memory of a computer, and specialists of the Flight Control Center contact this computer directly if corrections have to be made in the program. If necessary, the 'crew computer' itself will fire and cut off engines, wake up the cosmonauts, remind them of the day's agenda and signal them before the beginning of the next period of communications.

Are you interested in the condition of any of the station's systems? Feed in the system's code, and all of the data you need can be read on a screen.

When I arrived at the Flight Control Center on 19 March, work which was routine but at the same time quite intense was in progress from the start.

I remembered that flight director V. Ryumin had advised the crew to conserve their food until the "Progress" spaceship arrived, since the "Mir" station's snack bar was stocked with rations for only 20 days.

"Progress-25" was rapidly pursuing the complex "Mir"--"Soyuz T-15."

Five Soviet spacecraft were now operating in the same orbit.

I asked deputy flight director G. Oganesyants: "Managing so much flying equipment at a single time is probably difficult, isn't it?"

"It's not easy, of course," replied Georgiy Sarkisovich. "Strange as it may seem, we are concerned most of all about the 'Mir' station. You probably noticed that there are now very many unfamiliar faces at the control center. They are developers of systems of the station. All of its systems are either new or improved, and they are undergoing what are essentially space trials of the present time."

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CSO: 1866/139

TASS REPORTS DOCKING OF 'PROGRESS-25' WITH 'MIR'

Moscow IZVESTIYA in Russian 22 Mar 86 p 1

[TASS Report]

[Text] The spaceship "Progress-25" docked with the manned orbiting complex "Mir"--"Soyuz T-15" on 21 March 1986, at 1416 hours Moscow time.

The mutual search, approach, rendezvousing and docking of the spacecraft were carried out with the aid of automatic onboard systems. These operations were monitored by the Flight Control Center and the crew of the orbiting complex--cosmonauts Kizim and Solovyev. The cargo ship was docked to the station on the side of its equipment compartment.

The "Progress-25" ship carried into orbit fuel for the station's combined engine assembly, food products and water, as well as apparatus and equipment which are needed to ensure prolonged functioning of the "Mir" station as a base block of an intricate scientific-research complex.

According to telemetry data and the crew's reports, the onboard systems of the orbiting complex "Mir"--"Soyuz T-15"--"Progress-25" are functioning normally.

Leonid Kizim and Vladimir Solovyev are feeling well.

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TASS REPORTS COSMONAUTS UNLOADING 'PROGRESS-25', REFUELING 'MIR'

Moscow PRAVDA in Russian 26 Mar 86 p 1

[TASS Report]

[Text] Flight Control Center, 25 March. The space mission of Leonid Kizim and Vladimir Solovyev on board the orbiting complex "Mir"--"Soyuz T-15"--"Progress-25" is continuing.

Unloading the automatic transport spaceship and deploying delivered equipment on board the station was the main item on the crew's program of work during the days just past. The cosmonauts simultaneously carried out planned tests and adjusting of new systems and apparatus of the "Mir" station in the manned-flight mode.

Following the completion of preparatory operations for checking the airtightness of fuel lines and pumping out compressed nitrogen, tanks of the station are being refilled with fuel from tanks of the cargo spaceship. Plans for today call for correcting the orbit of the manned complex, using the cargo ship's engine.

According to telemetry data and the crew's reports, the flight is proceeding normally.

The condition of the health of Leonid Kizim and Vladimir Solovyev is good, and they are feeling well.

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COSMONAUTS BEGIN THIRD WEEK IN ORBIT

Moscow IZVESTIYA in Russian 29 Mar 86 p 1

[TASS Report]

[Text] Flight Control Center, 28 March. The third week of Leonid Kizim's and Vladimir Solovyev's mission in orbit has begun.

The cosmonauts have completed the unloading of the automatic transport spaceship "Progress-25." They have installed items of delivered equipment in their assigned places and are continuing planned tests of systems and apparatus of the "Mir" station. Yesterday they rehearsed various flight-control routines and checked the functioning of the on-board data-processing complex and radio communication equipment.

In line with the medical monitoring plan, the crew performed a comprehensive examination of their cardiovascular systems today. The day before the examination, the cosmonauts measured body mass and evaluated the condition of muscles which are not exerted much in conditions of space flight.

According to telemetry data and the crew's reports, the onboard systems of the manned complex "Mir"--"Soyuz T-15"--"Progress-25" are functioning normally.

The condition of the health of Leonid Kizim and Vladimir Solovyev is good, and they are feeling well.

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TASS REPORTS COSMONAUTS USE 'LUCH' COMMUNICATIONS RELAY SATELLITE

Moscow IZVESTIYA in Russian 30 Mar 86 p 1

[TASS Report]

[Text] Flight Control Center, 29 March. Cosmonauts Leonid Kizim and Vladimir Solovyev are continuing their mission on board the orbiting station "Mir."

In line with the designated program, tests were performed today with a new radio system which permits reliable communications between the crew and the Flight Control Center via a relay satellite when the manned complex is outside of the zone of radio visibility from the territory of the Soviet Union.

In the course of a trial period of two-way communication, the cosmonauts conducted a televised report in addition to exchanges of service communication. The artificial Earth satellite "Luch" ("Cosmos-1700"), which is located in geostationary orbit, was used as a relay in doing this.

The new, comprehensive radio communications system will permit a large expansion of the capabilities for controlling the intricate scientific research complex, and for increasing the volume of the information received from it and the speed at which this information is received.

The work in near-Earth orbit is proceeding in accordance with the designated program.

Cosmonauts Leonid Kizim and Vladimir Solovyev are healthy and are feeling well.

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COMMENTARY ON 'LUCH' DATA RELAY SATELLITE SYSTEM

Moscow IZVESTIYA in Russian 31 Mar 86 p 3

[Article by A. Ivakhnov, correspondent at the Flight Control Center]

[Excerpt] In the part of its orbital flight path that is the most favorable for communications, the orbiting scientific complex "Mir"--"Soyuz T-15"--"Progress-25" passes over the territory [of the USSR] for about 20 minutes. During this time, conversations with the crew are conducted, telemetry data are received from the spacecraft, and commands are sent to the station's systems.

This was the way that communication was accomplished with the "Salyut-7" and its predecessors. There is one major difference now: the "Mir" is much more complex than the previous stations. Consider that there are seven whole computers on it, and several times as much information has to be transmitted both ways. Tracking stations were not designed for such a heavy flow, and therefore they had to be re-outfitted before the "Mir" was launched. Compare the following figures: on one orbit, 100 commands are transmitted to the "Salyut-7," and now 300 must be transmitted to the "Mir." When the station becomes occupied with scientific modules, the number will grow to 1,000. Thanks to the new equipment of the tracking stations, the volume of information transmission has increased by approximately 10 times.

Nevertheless, this communications system is operable only during the period when the station is in the zone of radio visibility of ground tracking posts. At the most critical moments, scientific research ships which are on duty in the Atlantic, in the Mediterranean Sea and off the coast of the Far East are linked with the system.

Isn't it possible to arrange for the cosmonauts to be able to communicate with the Flight Control Center from any point of the orbit? Yes, it is. And now steps are under way to establish such communication.

Draw in your mind a line from the Baykonur Cosmodrome southward to the point where it crosses the equator. It is approximately above this point, at a very great altitude, that the communications satellite "Luch" ("Cosmos-1700") is hovering above the planet.

If we could be on this satellite and look out through a window, we would be able to see nearly one-half of the globe all at once. It is in this way that its radio systems can 'communicate' with the systems of the "Mir" for the entire period that the station is located over this half of the Earth.

The station has a narrow-beam antenna connected to a computer. When the location of the communications satellite is given to the computer, it issues the necessary commands to control systems. From this moment on, the narrow-beam antenna will turn so that it is always 'looking' at the satellite. In the same way, the "Cosmos-1700" will be looking with its antennas at the "Mir" when it is necessary. It will transmit all incoming information to a tracking station located near Moscow, on the outskirts of the Flight Control Center.

The first such period of communications took place on 29 March. The television link between Earth, the communications satellite and the "Mir" operated without trouble.

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TASS REPORTS 'REZONANS' EXPERIMENT, REFUELING ON 'MIR' STATION

Moscow PRAVDA in Russian 2 Apr 86 p 2

[TASS Report]

[Text] Flight Control Center, 1 April (TASS)--In line with the designated program, Leonid Kizim and Vladimir Solovyev are continuing tests of the orbiting station "Mir" in the manned-flight mode.

Yesterday the cosmonauts monitored the functioning of individual aggregates of equipment, and worked on adjusting the onboard data-processing complex. A technical experiment called "Rezonans" was performed for the purpose of determining dynamic characteristics of the complex space system consisting of a base block and two ships.

In line with the plan of operations with the automatic transport ship "Progress-25," two more fuel tanks of the station's combined engine unit were refueled, and the living compartments were pressurized with oxygen.

According to telemetry data and the crew's reports, the onboard systems of the manned complex "Mir"--"Soyuz T-15"--"Progress-25" are functioning normally.

The condition of the health of both cosmonauts is good, and they are feeling well.

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TASS REPORTS COSMONAUTS MONITOR WINTER CROPS

Moscow VECHERNYAYA MOSKVA in Russian 5 Apr 86 p 1

[TASS Report]

[Text] Flight Control Center, 4 April (TASS)--The third week of Leonid Kizim's and Vladimir Solovyev's tour of duty on board the orbiting scientific station "Mir" is ending.

The flight program during the days just past included further tests of improved systems and aggregates of the station, and installation of equipment delivered by the cargo spaceship. Together with this work, geophysical studies were begun in line with assignments from specialists of various branches of the country's economy.

Planned for the crew today are visual observations and photography of individual areas of republics of Central Asia, and of the Ukraine, Krasnodar Kray and the Caucasus using a hand-held camera. The purpose of this work is to evaluate possibilities for determining from space the condition of winter-sown crops after wintering.

The day's agenda calls also for checks on the functioning of onboard systems of the orbiting complex, medical monitoring, and physical exercises.

According to telemetry data and the cosmonauts' reports, the flight is proceeding normally.

The condition of the health of Leonid Kizim and Vladimir Solovyev is good, and they are feeling well.

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SUMMARY OF COSMONAUTS' 7 APRIL PRESS CONFERENCE

Moscow IZVESTIYA in Russian 8 Apr 86 p 2

[Article by A. Ivakhnov, correspondent at the Flight Control Center]

[Abstract] The article is a brief report on a press conference that was held via radio with the crew of the orbiting scientific station "Mir" on 7 April. Soviet and foreign journalists were invited to the Flight Control Center to ask questions of cosmonauts Leonid Kizim and Vladimir Solovyev. A number of the questions and the replies to them are recorded.

Asked about the tasks that have been posed for the operation of the station, the crew replied that when it becomes equipped with scientific modules, it will become a large laboratory for both basic research and work in the interests of the economy. Asked about possible visits of American or West German astronauts to the station, the cosmonauts replied they could not say anything about specific visits, adding that this would require appropriate agreements between countries.

Answering a question about the tragedy of the U.S. spaceship Challenger and the contentions of many Americans that work in space should be only for professionals, because space flight is too dangerous for untrained persons, the cosmonauts pointed out that the Challenger accident had nothing to do with the level of the crew's training. Noting that every mission must be preceded by careful training, including physical training, the cosmonauts observed that as the technology becomes more improved, the requirements placed on the physical condition of crew members become less stringent. They added that the time is not far off when scientists and specialists who are not in the best of health will be able to fly in space.

Asked about statements of U.S. officials that 80 percent of the Soviet space program is devoted to military objectives, the cosmonauts stated that their program contains absolutely no experiments for military purposes. They added that these claims of U.S. officials are a reflection of these officials' own plans.

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SOLOVYEV COMMENTS ON COSMONAUT SAFETY MEASURES

Moscow TRUD in Russian 8 Apr 86 p 4

[Article by I. Mogila]

[Abstract] The article records answers of cosmonauts Leonid Kizim and Vladimir Solovyev to questions of Soviet and foreign journalists at the press conference via radio which was held at the Flight Control Center on 7 April.

A U.S. journalist, referring to the tragedy of the space shuttle Challenger, asked about measures of the Soviet space program to minimize risk, and whether the USSR and the United States could cooperate in this field. Solovyev replied that there is a whole system of safety measures in the Soviet program, noting in particular that if an accident were to occur during the launch or climb of the rocket, the cabin holding the crew would separate from the rest of the ship and would be propelled by small engines to a safe distance, after which it would descend by parachute. Solovyev went on to recall that a great deal of attention was devoted to safety measures in the preparations for the joint Soviet-American flight in 1975, and he said further development of this cooperation would unquestionably be useful. He said it would be possible to begin preparations for such interesting projects as a joint flight to Mars, and the creation of large orbiting scientific complexes.

As a follow-up to the press conference, the journalists also met with leading Soviet scientists in space-related fields. Asked whether the orbiting stations "Mir" and "Salyut-7" would be linked up, V.A. Shatalov, director of training of Soviet cosmonauts, replied that the program did not call for this, and that there was no need for it. He noted that "Salyut-7" had been deactivated, but that after a check of its equipment, it could be possible that more research would be performed on it. Academician O.G. Gazenko, director of the Institute of Medical-Biological Problems, said that there are plans to launch another biological satellite next year. It is to carry two apes, several rats and other small animals. Finally, Shatalov replied to a question whether cosmonauts from other countries would work on the "Mir" station. He stated that two cosmonauts from Syria currently are in training, and that probably they would work on board "Mir."

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TASS REPORTS COSMONAUTS COMPLETE 25 DAYS ABOARD 'MIR'

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 9 Apr 86 p 1

[TASS Report]

[Text] Flight Control Center, 8 April. Cosmonauts Leonid Kizim and Vladimir Solovyev have been working on board the "Mir" station for 25 days.

A press conference with the crew on board the station took place yesterday. The cosmonauts responded to numerous questions from Soviet and foreign correspondents in the course of two periods of communications, one of which was a prolonged period using the relay satellite "Luch."

In line with the designated flight program, the crew is continuing tests of aggregates and systems of the station, and also is adjusting instruments today. The work schedule calls for conducting a technical experiment in order to evaluate the dynamics of external structural elements of the station, for monitoring the functioning of computer technology, and for correcting the orbit of the manned complex. Also planned are observations of geological features in the vicinity of the city of Dushanbe, and of winter-sown crops on the territory of republics of Central Asia.

The condition of the health of Leonid Kizim and Vladimir Solovyev is good, and they are feeling well.

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COSMONAUTS PERFORM MEDICAL EXAM WITH 'GAMMA' APPARATUS

Moscow IZVESTIYA in Russian 12 Apr 86 p 3

[TASS Report]

[Text] Flight Control Center, 11 April. Soviet cosmonauts Leonid Kizim and Vladimir Solovyev are observing an important anniversary--25 years since the first flight of a man in space--in near-Earth orbit. Many Cosmonautics Day greetings and wishes for a successful accomplishment of their mission are being sent to them.

Yesterday comrades Kizim and Solovyev underwent a medical examination, which was performed using a new multifunctional recording apparatus called "Gamma." Results of the examination indicate that the condition of the health of both cosmonauts is good. The commander's pulse rate at rest is 62, and the flight engineer's is 66 beats per minute. Their arterial pressures, respectively, are 115 over 70, and 120 over 70 millimeters of mercury.

The crew's schedule today calls for carrying out further tests of the "Mir" station, for visual observations of land surface and the waters of the world's oceans, and for physical exercise.

The onboard systems of the manned complex "Mir"--"Soyuz T-15"--"Progress-25" are functioning normally.

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COSMONAUTS CONTINUING TESTS, INSTRUMENT CHECKS

Moscow PRAVDA in Russian 16 Apr 86 p 1

[TASS Report]

[Text] Flight Control Center, 15 April. Leonid Kizim and Vladimir Solovyev have been carrying out their duties on board the orbiting scientific station "Mir" for one month.

In line with the designated flight program, the cosmonauts are continuing testing of elements of the structure, equipment and instrumentation of the station.

In particular, today they are checking the functioning of units of the heat-control system in various modes of operation, and they are conducting a test of a backup set of radio communications equipment.

The day's schedule calls also for visual observations of individual regions of the Earth's surface, and physical exercise on the training equipment.

Another medical examination of Leonid Kizim and Vladimir Solovyev was performed yesterday for the purpose of comprehensive evaluation of the condition of the crew's health, and for adjusting the new clinical apparatus "Gamma." According to results of the examination, both cosmonauts are healthy and are feeling well.

The flight of the manned complex "Mir"--"Soyuz T-15"--"Progress-25" is proceeding normally.

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COSMONAUTS BEGIN SIXTH WEEK OF SPACEFLIGHT

Moscow PRAVDA in Russian 19 Apr 86 p 2

[TASS Report]

[Text] Flight Control Center, 18 April. Leonid Kizim and Vladimir Solovyev are into their sixth week of space flight.

Along with testing the new orbiting station "Mir," the crew is doing a substantial volume of work for the program of studies of the Earth's natural resources and environment. At the present time, the cosmonauts are using methods developed by the state center "Priroda" (nature) to conduct several series of visual observations of typical objects in nature. The purpose of the observations is to study effects of atmospheric disturbances and conditions of illumination on geophysical studies.

To determine dynamic characteristics of the "Mir" station and the magnitude of stresses acting on it, the technical experiment "Rezonans" was done yesterday. The experiment was performed in the course of making a correction of the complex's orbit.

According to telemetry data and the crew's reports, the onboard systems of the manned complex "Mir"--"Soyuz T-15"--"Progress-25" are functioning normally. Its orbit parameters are: maximum distance from the surface of Earth--360 kilometers; minimum distance from the surface of Earth--336 kilometers; period of revolution--91.3 minutes; inclination--51.6 degrees.

Cosmonauts Leonid Kizim and Vladimir Solovyev are healthy and are feeling well.

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TASS REPORTS 'PROGRESS-25' UNDOCKS FROM 'MIR'

Moscow GUDOK in Russian 22 Apr 86 p 1

[TASS Report]

[Text] Flight Control Center, 21 April. The flight of the automatic cargo spaceship "Progress-25," which was launched into near-Earth orbit on 19 March 1986, has been completed. This spaceship docked with the orbiting complex "Mir"--"Soyuz T-15" on 21 March. All planned operations were carried out completely, including the unloading of the spaceship, refueling of the station's combined engine unit, and pumping of drinking water. Several corrections of the manned complex's orbit were executed with the aid of the automatic spaceship's engine.

The automatic spaceship "Progress-25" was separated from the "Mir" station on 20 April at 2324 hours Moscow time. The ship's braking engine was fired at the calculated time. As a result of braking, the spaceship went into a descending trajectory, entered the dense layers of the atmosphere, and ceased to exist.

Cosmonauts Leonid Kizim and Vladimir Solovyev are continuing planned work on board the orbiting complex "Mir"--"Soyuz T-15." Today the crew will check individual units of the station's life support system and perform another series of visual observations and photography of a number of areas of the waters of the Atlantic Ocean.

According to telemetry information and the crew's reports, the flight is proceeding normally.

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MANNED MISSION HIGHLIGHTS

LAUNCH OF 'PROGRESS-26' CARGO SHIP

Moscow IZVESTIYA in Russian 25 Apr 86 p 1

[Text] In line with the program for ensuring the further functioning of the orbiting scientific station "Mir," the automatic cargo spaceship "Progress-26" was launched from the Soviet Union on 23 April 1986 at 2340 hours Moscow time.

The purpose of the launching of the ship is to deliver consumable materials and various cargo items to the orbiting station.

The "Progress-26" ship was placed into an orbit with the parameters: maximum distance from the surface of Earth--274 kilometers; minimum distance from the surface of Earth--190 kilometers; period of revolution--88.8 minutes; inclination--51.6 degrees.

According to telemetry data, the onboard systems of the automatic cargo ship are functioning normally.

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TASS REPORTS DOCKING OF 'PROGRESS-26' WITH 'MIR' STATION

Moscow VECHERNYAYA MOSKVA in Russian 28 Apr 86 p 1

[TASS Report]

[Text] On 27 April at 0126 hours Moscow time, the "Progress-26" ship docked with the manned orbiting complex "Mir"--"Soyuz T-15."

The mutual search, approach, rendezvousing and docking were carried out with the aid of onboard automatic equipment of the spacecraft. These processes were monitored by the Flight Control Center interacting with the ground command-and-measurement complex, and also by cosmonauts Kizim and Solovyev. The cargo ship docked with the station on the side of its equipment compartment.

The "Progress-26" ship delivered into orbit fuel for the combined engine unit, food and water, equipment and apparatus for the further equipping of the "Mir" station, and also mail.

According to telemetry data and the crew's reports, the onboard systems of the manned complex "Mir"--"Soyuz T-15"--"Progress-26" are functioning normally. The condition of the health of Leonid Kizim and Vladimir Solovyev is good, and they are feeling well.

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TASS REPORTS CREW UNLOADING 'PROGRESS-26', PERFORMING VISUAL OBSERVATIONS

Moscow SOVETSKAYA ROSSIYA in Russian 1 May 86 p 1

[TASS Report]

[Text] Flight Control Center, 30 April. Leonid Kizim and Vladimir Solovyev are completing their seventh week of orbital flight.

Over the last days, the crew of the manned complex has been busy unloading the automatic cargo spaceship "Progress-26," and they have performed operations for the further outfitting of the "Mir" station with new instruments and equipment. Geophysical experiments in line with the program for study of the Earth's natural resources and environment were also performed.

Today, the cosmonauts will continue work with the cargo spaceship, complete a series of visual observations and manual photography of individual regions of the Earth's surface, and do physical exercises for two hours.

On 1 May the crew will rest. A TV report from Red Square on the holiday demonstration of the working people is planned for the cosmonauts.

According to telemetry data and reports from orbit, the flight of the manned complex "Mir"--"Soyuz T-15"--"Progress-26" is proceeding normally. Leonid Kizim and Vladimir Solovyev are feeling well.

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TASS REPORTS FLIGHT PLAN CALLS FOR COSMONAUTS TO TRANSFER TO 'SALYUT-7'

Moscow IZVESTIYA in Russian 4 May 86 p 1

[TASS Report]

[Text] Flight Control Center, 3 May. Leonid Kizim and Vladimir Solovyev have been working on the orbiting station "Mir" for 50 days. During this time the cosmonauts have performed comprehensive tests of its structure, aggregates and onboard systems, and they have installed extra equipment that was delivered to the station by two automatic cargo ships.

The first stage of the manned flight of the station is coming to an end. In line with the program of further work in space, the plan calls for comrades Kizim and Vladimir Solovyev to fly over to the orbiting complex "Salyut-7"--"Cosmos-1686," which has been functioning in the automatic mode since 21 November 1985. The separation of the "Soyuz T-15" ship from the "Mir" station is scheduled for 5 May.

Today the crew began operations for deactivating instrumentation and individual aggregates of the station. The day's schedule calls also for a medical check and for physical exercise.

According to telemetry data and reports from orbit, the onboard systems of the manned complex "Mir"--"Soyuz T-15"--"Progress-26" are functioning normally.

The conditions of the health of both cosmonauts is good, and they are feeling well.

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DEPUTY FLIGHT DIRECTOR BLAGOV COMMENTS ON COSMONAUTS' TRANSFER TO 'SALYUT-7'

Moscow IZVESTIYA in Russian 4 May 86 p 3

[Article by A. Ivakhnov, correspondent at the Flight Control Center]

[Excerpt] Cosmonauts Leonid Kizim and Vladimir Solovyev are completing work on board the orbiting scientific station "Mir." Unlike the "Mayakis'" [the crew's callsign] last mission, when they spent a record length of time in space, performing numerous scientific experiments and receiving guests on the "Salyut-7" station and also taking a space walk, there has been nothing of this sort on the "Mir" Station. They have settled the new station, received and unloaded a cargo spaceship and installed the equipment it delivered; they have carefully checked and adjusted every system of the "Mir," including all of its electronics (there are seven computers on it); they have tested communications via a geostationary satellite. During hours that have been comparatively free, they have engaged in 'microscience,' photographing the Earth and tending to plants. They have received a new transport ship and started unloading it....

Since all of the equipment of the "Mir" (about 1,000 instruments) is either entirely new or is improved technology, it is quite natural that 'sticky problems' have arisen: it has been necessary to probe circuits and seek out causes. In special cases, consultations have been held with specialists at the Flight Control Center.

Finally at a press conference on the eve of the 1 May holiday, deputy flight director V. Blagov reported that the equipment on the "Mir" had been put into ideal working order, that all the technical 'weeds' had been pulled out, and that the station was 'tuned and playing like a grand piano.' Thus the work that had been planned for the "Mayaki" at this stage of the mission was totally fulfilled.

The "Mayaki," however, are not preparing to return to Earth right now. According to the program, they are preparing to fly over to the orbiting station "Salyut-7." Therefore they are putting baggage not only into the re-entry vehicle of the "Soyuz T-15" but also into its living compartment. It already contains elements of equipment which are for replacing counterparts which have depleted their service life on the "Salyut-7." All of this was delivered by the cargo ships. The cosmonauts will take along their 'livestock'--plants and other objects of research.

In the choosing of the crew for the present mission, a decisive factor was the fact that the "Mayaki" are well-familiar with the "Salyut-7" station. It may seem at first glance that the upcoming move represents a return to old matters. It would seem that whereas the "Salyut-7's" rooms are crammed with scientific gear--the "Progress" ships have delivered so much that the station's total weight has nearly doubled--the "Mir" on the other hand is roomy and comfortable, and the cosmonauts could go to work in the scientific and technological modules that are to be docked with it.

But V. Blagov talked about considerations of other work that lies ahead. For an observatory-block to operate successfully, for example, it is essential that its telescopes be pointed at the stars that are to be studied. Windows of a module for observing the Earth's surface must be oriented toward Earth. Certain technological experiments must not be disturbed by vibrations. If these modules were to be attached together rigidly, the operations would have to be carried out in stages, turning the complex first this way, and then that way.

This means that it is expedient that certain space laboratories should fly independently, and that crews visit them for inspection and repair or instruments, and for returning results of their work first back to the base-block, and subsequently to Earth. In all likelihood, in addition to stations of the "Mir" type, there will be a need for a kind of orbiting Flight Control Center--a large platform with service and storage areas, as well as space 'taxis' for delivering crews and cargo to these spacecraft. Shuttle flights from one station to another will become routine.

The upcoming shuttle flight of the "Mayaki" will open a new page in the exploration and utilization of space, and their "Soyuz T-15" will go down in history as the prototype of orbiting 'taxis.'

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TASS REPORTS 'SOYUZ T-15' UNDOCKS FROM 'MIR'

Moscow IZVESTIYA in Russian 7 May 86 p 1

[TASS Report]

[Text] Flight Control Center, 5 May. Cosmonauts Leonid Kizim and Vladimir Solovyev have successfully fulfilled the first phase of work on board the "Mir" station.

Today at 1612 hours Moscow time, the separation of the manned ship "Soyuz T-15" from the orbiting complex "Mir"--"Progress-26" was carried out. The program of future flight for the spaceship calls for rendezvousing and docking with the scientific research complex "Salyut-7"--"Cosmos-1686." The docking of the spacecraft is scheduled for 6 May.

According to telemetry data, the onboard systems of the "Soyuz T-15" spaceship and of both space complexes are functioning normally.

The condition of the health of Leonid Kizim and Vladimir Solovyev is good, and they are feeling well.

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TASS REPORTS DOCKING OF 'SOYUZ T-15' WITH 'SALYUT-7'

Moscow GUDOK in Russian 8 May 86 p 1

[TASS Report]

[Excerpt] In line with the flight program, cosmonauts Leonid Kizim and Vladimir Solovyev docked the spaceship "Soyuz T-15" with the orbiting complex "Salyut-7"--"Cosmos-1686" on 6 May 1986, at 2058 hours Moscow time. A flight from one orbiting station to another has been made for the first time in the practice of manned space flights.

The rendezvousing and docking of the spaceship with the station were accomplished in several stages. Two corrections of the trajectory of movement of the "Soyuz T-15" spaceship were executed in the course of its autonomous flight, as a result of which the ship went into the orbit of the complex "Salyut-7"--"Cosmos-1686" and began its approach to the complex at a distance of about 5 kilometers. Further rendezvousing and guidance operations were performed by the crew manually, using an onboard computer and optical instruments.

The crew's precise and well-coordinated actions ensured approach and docking at the calculated time. After checking the seal of the docking mechanism, the cosmonauts went inside the station.

In the course of their flight on board the "Salyut-7" station, comrades Kizim and Solovyev will continue scientific-technical research and experiments specified by the program for operation and use of the station, and they will also perform a number of routine preventive-maintenance operations.

According to telemetry information, the flights of the manned complex "Salyut-7"--"Soyuz T-15"--"Cosmos-1686" and the automatic complex "Mir"--"Progress-26" are proceeding normally.

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COSMONAUTS' TRAINING FOR TRANSFER, ROLE OF 'COSMOS-1686'

Moscow IZVESTIYA in Russian 7 May 86 p 2

[Article by A. Ivakhnov, correspondent at the Flight Control Center]

[Abstract] The article reports on the preparations of Leonid Kizim and Vladimir Solovyev for the operation to undock their "Soyuz T-15" ship from the "Mir" orbiting station and to fly over and dock with the "Salyut-7"--"Cosmos-1686" complex.

It is reported that on 2 and 3 May, the cosmonauts practiced for this operation. It is noted that the "Soyuz T-15" ship is well-equipped for such a maneuver. In addition to a laser range-finder, which permits the distance to the orbiting station to be determined beginning from a range of 5,000 meters, and an optical sight for orientation on the station and a night vision device, the ship has a minicomputer for calculating rendezvousing parameters and correction pulses.

A. Belozerov, who is the crew's instructor for rendezvousing procedures, was quoted as saying that approximately one-fifth of the crew's training time for this operation involved practicing routine situations, and the remainder was devoted to practicing non-routine situations with all kinds of possible complications. For such situations, there are alternate approaches to the docking, with sufficient reserve fuel for carrying them out.

Information is provided on the "Cosmos-1686" ship that is docked with the "Salyut-7" station. It is referred to as a prototype of scientific modules that will dock with orbiting stations in the near future, particularly the "Mir" station. While it has been in the automatic, unmanned flight mode with the "Salyut-7," "Cosmos-1686" has been running a variety of automated studies. They have involved observations of emissions of gases, ash and other substances from volcanoes and of their spreading in the atmosphere, with the aid of telescope-spectrometers. Cosmic particles also have been studied from "Cosmos-1686."

It is noted that as the "Soyuz T-15" ship approached, the complex was to be rotated with the "Salyut-7" station's docking port pointed toward the ship, using engines and automation of the "Cosmos-1686."

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CREW PHYSICIAN COMMENTS ON COSMONAUTS' EASY ADAPTATION TO WEIGHTLESSNESS

Moscow KOMSOMOLSKAYA PRAVDA in Russian 7 May 86 p 4

[Article by S. Leskov (Flight Control Center)]

[Abstract] The brief article reports on activities at the Flight control Center during the shuttle flight of the "Soyuz T-15" spaceship from the "Mir" orbiting station to the "Salyut-7"--"Cosmos-1686" orbiting complex. Comments of control center personnel, including flight director V. Ryumin, are recorded. The "Soyuz T-15" crew's physician, Aleksandr Kulev, was quoted as saying that cosmonauts Leonid Kizim and Vladimir Solovyev adapted to zero-gravity very quickly at the beginning of their mission. They experienced no dizziness or nausea. He wondered if the relatively short time between this crew's last flight, which was a record 237 days, and the present one may have had something to do with the ease of their adaptation.

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DETAILS OF 'SOYUZ T-15' TRANSFER FLIGHT TO 'SALYUT-7'

Moscow TRUD in Russian 7 May 86 p 4

[Article by V. Golovachev, special correspondent at the Flight Control Center]

[Excerpt] For the first time in the practice of space flight, the Soviet crew consisting of Leonid Kizim and Vladimir Solovyev has flown from one orbiting station to another. The crew executed a number of intricate maneuvers in near-Earth space.

When the spaceship "Soyuz T-15" separated gently from the orbiting complex "Mir"--"Progress-26" on 5 May, the distance from the complex to "Salyut-7," which was flying ahead of it, was more than 3,000 kilometers. It took "Soyuz T-15" almost 29 hours to travel this distance in space. During that time, all three of the space objects--the two orbiting complexes and the "Soyuz T-15" ship--orbited the globe 19 times.

The main objective of ballistics support specialists in this connection was to make the cross-flight with minimal consumption of energy. This meant using the spaceship's fuel wisely and as efficiently as possible. Fuel was needed for both the ship's sustainer rocket engine--a liquid-propellant engine--and 26 less powerful rendezvousing and orientation engines with which the transport ship is equipped.

The spaceship and both of the stations were located on the same plane. Although the spaceship could have remained on it, a far more economical plan was followed. The ship descended to a lower orbit, cut off its engine, and then flew around the Earth faster than the station.

The ship, in a low orbit, thus overtook the station because its path was shorter. But then came the moment when it would have to climb to the station's orbit. "Soyuz T-15" then reassumed a strictly oriented attitude, its engine was fired, and the spaceship shot up to the higher orbit, approaching "Salyut-7."

There is one more detail that should be emphasized. It was important not simply to rendezvous the spaceship with the station but to select a moment for this when the docking mechanism on "Salyut-7" was at an angle of 45 degrees to the sun, so that the mechanism would cast an oblique shadow and the sun would not blind the ship's crew.

This was important also because the crew docked the spaceship manually. The advancement of space navigation requires cosmonauts to be able to maneuver freely in near-Earth space. Each flight of this kind enriches their experience.

The date and time of the docking of "Soyuz T-15" with "Salyut-7"--6 May at 2058 hours--were pre-announced to journalists by deputy flight director V.D. Blagov as early as the end of April. This schedule was met with striking precision.

Leonid Kizim, Vladimir Solovyev and Oleg Atkov worked for 237 days on board the "Salyut-7" station in 1984. This was the longest orbital mission. L. Kizim and V. Solovyev are now performing routine maintenance operations on board the station, and are doing research and experiments which are specified by the mission program.

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TASS REPORTS COSMONAUTS REACTIVATING 'SALYUT-7'

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 9 May 86 p 1

[TASS Report]

[Text] Flight Control Center, 8 May. Leonid Kizim and Vladimir Solovyev are into their third day of work on board the orbiting complex "Salyut-7"--"Soyuz T-15"--"Cosmos-1686."

In line with the designated program, the cosmonauts are continuing operations for putting the "Salyut-7" station into the manned-flight mode. In particular, they have reactivated the station's life-support system, and checked the functioning of radio communication equipment and the condition of control units, instruments and equipment.

Plans for today call for routine maintenance operations with temperature-control and power-supply systems, and monitoring of individual units of automation equipment, as well as power lines of the station.

According to data from trajectory measurements, the orbit parameters of the manned complex "Salyut-7"--"Soyuz T-15"--"Cosmos-1686" at the present time are: maximum distance from the surface of Earth--360 kilometers; minimum distance from the surface of Earth--336 kilometers; period of revolution--91.2 minutes; inclination--51.6 degrees.

The flight is proceeding normally. The condition of the health of Leonid Kizim and Vladimir Solovyev is good, and they are feeling well.

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COSMONAUTS CONTINUE CHECKOUT OF 'SALYUT-7'

Moscow IZVESTIYA in Russian 12 May 86 p 1

[TASS Report]

[Text] Flight Control Center, 11 May. The manned flight of the orbiting complex "Salyut-7"--"Soyuz T-15"--"Cosmos-1686" is continuing.

In line with the designated program of work, Leonid Kizim and Vladimir Solovyev were busy checking the functioning of systems and aggregates of the station over the past 2 days.

Today the crew is scheduled to perform a number of routine maintenance operations with the temperature-control system, and to replace individual units whose service lives have been depleted.

According to telemetry data and reports from orbit, the flight of the manned complex "Salyut-7"--"Soyuz T-15"--"Cosmos-1686" is proceeding normally. Parameters of the microclimate in the living compartments are: temperature--18 degrees Celsius; pressure--748 millimeters of mercury.

Cosmonauts Leonid Kizim and Vladimir Solovyev are healthy and are feeling well.

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COSMONAUTS COMPLETING REACTIVATION OF 'SALYUT-7'

Moscow IZVESTIYA in Russian 14 May 86 p 1

[TASS Report]

[Text] Flight Control Center, 13 May. Leonid Kizim and Vladimir Solovyev have been working in space for 2 months. During this time they successfully tested the design of aggregates and systems of the new orbiting station "Mir," and installed additional equipment that was delivered by two cargo ships.

According to the program, the crew made a flight over to the "Salyut-7" station, where they are now working. The cosmonauts are completing the reactivation of the station. Yesterday they were busy checking the functioning of the orientation system in the manned mode, and they replaced one of the instruments in the system for control of the engines.

Plans for today call for preventive maintenance and test operations involving individual elements of electrical lines, and also for physical exercise on the exercise cycle and running treadmill.

According to reports from orbit and telemetry data, the flight of the manned complex "Salyut-7"--"Soyuz T-15"--"Cosmos-1686" is proceeding normally.

Cosmonauts Leonid Kizim and Vladimir Solovyev are healthy, and they are feeling well.

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COSMONAUTS COMPLETE SECOND WEEK ON 'SALYUT-7'

Moscow PRAVDA in Russian 21 May 86 p 1

[TASS Report]

[Text] Flight Control Center, 20 May. Cosmonauts Leonid Kizim and Vladimir Solovyev have been working on board the station "Salyut-7" for 2 weeks. In this time they have carried out the reactivation of the station and also performed planned preventive maintenance operations.

In line with the program of geophysical studies, the crew has performed a series of visual observations of the Earth's surface, particularly of biosphere preserves on the territory of the Soviet Union. Using the mass spectrometry apparatus "Astra," they have performed a number of experiments for determining parameters of the atmosphere surrounding the orbital complex.

In line with the plan of medical monitoring, a comprehensive examination of the crew was performed over the past days. It included study of the cosmonauts' cardiovascular systems, measurement of body weight, and also an evaluation of the condition of muscles that are not exerted much in conditions of zero gravity.

The results of the medical examination show that comrades Kizim and Solovyev are healthy.

The flight of the manned complex "Salyut-7"--"Soyuz T-15"--"Cosmos-1686" is continuing.

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TASS ANNOUNCES LAUNCH OF 'SOYUZ TM'

Moscow IZVESTIYA in Russian 22 May 86 p 1

[TASS Report]

[Text] On 21 May 1986, at 1222 hours Moscow time, an improved ship, "Soyuz TM," was launched in an unmanned version.

The purpose of the launch is to conduct a comprehensive, experimental test of the ship in independent flight and also in flight together with the orbiting station "Mir."

Ships of the new series are intended for delivering crews to multipurpose manned complexes of the modular type.

The "Soyuz TM" ship was developed on the basis of the manned ship "Soyuz T." New systems are installed on it, including a rendezvousing and docking system, a radio communications system, an emergency rescue system, and also a new combined engine unit and a parachute system.

The ship was placed into an orbit with the parameters: maximum distance from the surface of Earth--240 kilometers; minimum distance from the surface of Earth--200 kilometers; period of revolution--88.6 minutes; inclination--51.6 degrees.

Telemetry data indicate that the ship's onboard systems are functioning normally.

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MANNED MISSION HIGHLIGHTS

'SOYUZ TM' DOCKS WITH 'MIR'

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 24 May 86 p 1

[TASS Report]

[Text] On 23 May 1986, at 1412 hours Moscow time, the unmanned transport ship "Soyuz TM" docked with the orbiting complex "Mir"--"Progress-26," which has been flying in the automatic mode since 5 May.

During the two-day independent flight of the ship, tests of its onboard systems, equipment and structural elements were conducted. A correction of the ship's trajectory of movement was executed for the purpose of putting it into an assembly orbit.

The mutual search, approach, rendezvousing and docking of the "Soyuz TM" ship with the "Mir" station were accomplished with the aid of onboard automatic equipment of both spacecraft. The ship was docked to the station on the side of the station's adapter module.

The program of joint flight calls for testing the improved ship "Soyuz TM" as part of an orbiting complex.

At the present time, two Soviet scientific research complexes are functioning in near-Earth orbit: "Mir"--"Soyuz TM"--"Progress-26," which is in the automatic mode, and "Salyut-7"--"Soyuz T-15"--"Cosmos-1686," which is manned.

The flight of both complexes is proceeding normally. The condition of the health of comrades Leonid Kizim and Vladimir Solovyev is good, and they are feeling well.

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RYUMIN COMMENTS ON 'KURS' DOCKING SYSTEM, NEW FEATURES OF 'SOYUZ TM'

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 24 May 86 p 3

[Article by G. Lomanov, correspondent at the Flight Control Center]

[Abstract] The article reports communications exchanges between the crew of L. Kizim and V. Solovyev and the Flight Control Center as the cosmonauts did an experiment called "Astra" to measure the composition of the atmosphere around the "Salyut-7" station, and it records comments of flight director Valeriy Viktorovich Ryumin regarding the new spaceship "Soyuz TM," which had just docked with the orbiting station "Mir." Ryumin related the following:

"First of all, a new docking system is being tested on this flight. Its appearance has nothing to do with any kind of bad performance on the part of the former system, although, naturally, requirements for reliability constantly are being upgraded. The 'Igla' system with which ships have been equipped for many years is not suitable for the 'Mir.' With it, not only is the ship oriented on the station, but the station is also oriented on the ship, with the engines of both spacecraft working. When the 'Mir" begins functioning with scientific modules docked to it, the complex will turn into an unsymmetrical structure, with varying configurations depending on the number of modules docked to it. Orienting such a 'bundle' is more complex, and more fuel would have to be expended. The new docking system called 'Kurs' maneuvers only the ship; it is of no consequence for it which position the 'Mir' is in. This means that the station will not expend any fuel at all during rendezvousing."

Reminded that the "Soyuz TM" ship looks much like its predecessor, Ryumin was asked if it was different inside:

"It is practically entirely new. It has another, more reliable engine unit. Instead of an elastic divider, a metal one has appeared between the fuel and the pressurization gas in the fuel tanks. When [the ship is] parked for a long time, gas can leak through an elastic membrane, creating a danger of malfunctions in the engines' operation. This possibility now is precluded. The ship is equipped with new instrumentation for communications. There are modern lightweight and durable materials--they have permitted a new parachute system for descending to be installed. The engine unit of the emergency rescue system has become lighter. In sum, if you compare the new ship with the 'Soyuz,' about all that has remained the same is the docking mechanism and a few other little things."

Asked if the new ship could carry a heavier payload thanks to the lighter structural elements, Ryumin replied:

"Yes, Sending it into space, we will have a reserve of about 200 kilograms. And when returning to Earth, we will carry 70-90 kilograms more than in the past. The difference between the 'outbound' and 'inbound' weights surprises you? Let me remind you: before taking off we can put cargo in the living compartment, but on the return there is only the reentry vehicle for this."

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DEPUTY FLIGHT DIRECTOR BLAGOV COMMENTS ON 'SOYUZ TM'

Moscow TRUD in Russian 24 May 86 p 2

[Article by V.D. Blagov, deputy flight director]

[Excerpt] Space technology is constantly improving and advancing. Time passes, and the time comes when a ship or station becomes obsolescent and can no longer perform its functions effectively. New solutions must be found and more up-to-date models developed. This is what happened to the spaceship "Soyuz T." Now that the "Mir" station has appeared, this ship must yield its place to the improved "Soyuz TM" model.

This spaceship, which is of a new series, was developed on the basis of the "Soyuz T." Taken into account in the new ship's development were many years of experience with the operation of the earlier model, as well as demands made for the operation of the third-generation station "Mir."

Since every change cannot be related in the space of a short article, I shall mention only the main ones. A new radio system for measuring the movement of the ship and the station relative to each other during rendezvousing and docking had to be developed to replace the "Igla" system which is now in use. The new system possesses heightened reliability and long range, and perhaps most importantly, it does not require mutual orientation of the 'passive' station and the approaching 'active' spaceship.

All of this permits the saving of a substantial amount of the station's fuel. It can be used for conducting scientific experiments. Another important feature is that the "Soyuz TM" can dock with the non-oriented station if any failure of its systems occurs.

A new system for radio communication with crews has also been installed. It has become possible to communicate separately with both members of a crew at the same time, and the quality of communication has improved. It has become possible to relay the crew's voices from "Soyuz TM" to the "Mir" station and beyond, to the Flight Control Center, via the station's pencilbeam antenna and the stationary communications satellite "Luch."

These major changes in principal systems of the spaceship necessitated an unmanned launch for the purpose of testing it completely in space conditions, despite the extensive proving-out which the ship underwent on the ground.

This test flight will open the way for a manned flight into space on board a "Soyuz TM" spaceship.

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STAR CITY: ON THE 25TH ANNIVERSARY OF THE COSMONAUT TRAINING CENTER

Moscow ZEMLYA I VSELENNAYA in Russian No 5, Sep-Oct 85, pp 73-79

[Article by L. M. Yershov under the rubric "From the History of Science"]

[Text] How swiftly time flies! That to which we were witnesses is becoming history. Already almost a quarter of a century separates us from that day when a man flew into open space for the first time. Over these years our manned space program has made an enormous journey. From the first Vostok spaceships to the orbital stations--laboratories equipped with thousands of instruments, the most complex units and scientific research equipment. From the first flight of Yu. A. Gagarin, lasting 108 minutes, to the multimonth work in orbit of L. D. Kizim, V. A. Solovyev, and O. Yu. Atkov.

Up to the present more than 200 people have been in space--Soviet cosmonauts, American astronauts and representatives of other nations.

THE FIRST STEPS

On 4 October, 1957, the joyous news flew around the world--the first artificial Earth satellite in the history of the world had been launched into space from the Soviet Union. This was then followed by launches of rockets to the moon, the flights of automatic stations to Venus and launches of satellites with living creatures aboard, which gave rise to the hope that soon a man himself would be lifted into space.

And already by January, 1959, work had begun which was associated with the biomedical training of a person for a flight into space. At the same time, they began creating the necessary systems and units, designing special space vehicles and launch vehicles, organizing communications stations and flight control stations and completing the launch complexes.

The solution of complex biomedical problems associated with maintaining the vital activitiy of the human body under the conditions of a space flight was undertaken by V. I. Yazdovskiy, A. D. Seryapin, A. V. Pokrovskiy and others. Academicians V. P. Chernigovskiy and V. V. Parin gave advice on the work. They all worked in close contact with the chief designer of space rocket systems, S.P. Korolev.

At the very first stage of the preparatory work the question arose: from what group of people in which profession should the future cosmonauts be selected? Mdeical personnel correlated data on, as well as the training experience of, pilots, tankmen, submariners, arctic explorers, mountaineers... The conclusion was unequivocal--the most suitable candidates for cosmonauts were fighter pilots. S. P. Korolev then roughly defined the future cosmonauts thus: "For this purpose a pilot is the most suitable person of all and the fighter pilot, first and foremost. He is indeed a general-purpose specialist. He is a pilot and a navigator and a signalman and a flight engineer. And, being a member of the military, he possesses the necessary moral and resolute qualities: he is noted for his collectedness , his discipline and his unbending striving to achieve the established goal."

In June, 1959, specialists in the field of aviation and space medicine, together with representatives from the design bureaus and a number of scientific research institutes, put together the first general plan for the selection and training of cosmonauts. The selection of candidates from the air units and formations was conducted by a group of specialists under the supervision of Ye. A. Karpov, an experienced doctor, a participant in the Great Patriotic War and a candidate of medical sciences. In August they began creating the material and technical base necessary for training the future cosmonauts, including the laboratories.

THE "GAGARIN" DETACHMENT AND ITS MENTORS

In January, 1960, The Cosmonaut Training Center [CTC] began its work. (Somewhat later it was decided to observe the birthdate of the center in April.) Ye. A. Karpov became its first chief. He did an enormous amount of work on the selection of personnel and on the make-up of the staff, on the search for the necessary equipment and on the improvement of the plans for the construction of special buildings.

The candidates for cosmonaut training were selected. After a medical examination a group of people remained and these made up the first cosmonaut detachment. Now it is called the "Gagarin" detachment. The oldest of them was a 30-year-old squadron commander, Pavel Belyayev. Younger by 2 years was a captain-engineer, Vladimir Komarov, also a skilled fighter pilot, Pavel Popovich. Senior lieutenants Valeriy Bykovskiy and Yuriy Gagarin and Lieutenant Aleksey Leonov were then 26 years old, and German Titov was 25. The rest of the candidates were also aged 25 to 30.

Then, at the beginning of 1960, N. P. Kamanin was appointed administrator of the cosmonaut program. One of the first Heroes of the Soviet Union, the commander of an air assault division and later a corps during the years of the Great Patriotic War, energetic and initiative, an excellent educator, he was always the highest authority for the pilot-cosmonauts.

Active construction began on the CTC. The walls of the future buildings began to grow quickly--the hotel, the restaurant, the training buildings, the housing...

Fig. 1. Star City--these well-built living quarters and the splendedly planned sections--this is how anyone who stayed here remembers the place.

Fig. 2. Cosmonaut No 1, Yu. A. Gagarin, at a pre-flight training session in the cabin of the Vostok spaceship.

In the beginning the basic studies were set up in accordance with the medical training plan, plane flights were made, such important disciplines as astronomy, the dynamics of space flight, navigation and others were studied. One question arose constantly: how best to prepare the future space explorers? For this reason, creatively thinking and highly skilled specialists were required. And aviation engineers and methodologists, flight instructors and parachutists, doctors and instructors for the various disciplines, as well as office, industrial and professional workers were sent to Star City.

With a great deal of affection the cosmonauts remeber their first mentors and the organizers of the CTC--Ye. A. Karpov, N. F. Nikeryasov (first commisar), Ye. Ye. Tselikin (flight instructor), N. K. Nikitin (jump instructor), Engineer B. V. Yakovlev and Doctor G. F. Khlebnikov. M. L. Gallay, an Honored Test Pilot of the USSR, did a lot of methodological work. Flight dynamics, the design of the spaceship and its on-board systems and other subjects were taught by leading specialists, scientists and engineers--K. D. Bushuyev, K. P. Feoktistov, O. G. Makarov and V. I. Sevastyanov.

The chief designer, S. P. Korolev, followed the cosmonauts' training very attentively. More than once he talked with them about space flights and the prospects and difficulties of their chosen path. The first cosmonauts will never forget these meetings. This is how A. G. Nikolayev, twice Hero of the Soviet Union and Pilot-Cosmonaut of the USSR, speaks about one of them: "Particularly memorable was our meeting with him when, at his invitation, we visited the design bureau for the first time. Sergey Pavlovich told us then very captivatingly about space rockets and spaceships and about the future of manned space flights. After the talk he invited us into the shops where they were building the Vostok spaceships. For the first time, instead of models, we were seeing the actual spaceships on which we were supposed to fly. We were both amazed and astonished at the scope of the construction of such a miracle of technology. We were filled with pride in the scientists and designers, and the engineers and workers-- the creators of space technology."

THE FIRST TEN YEARS

In the summer of 1960, at the CTC, the first testing units and equipment for the training sessions began to arrive. In order to create weightlessness, a TU-104 passenger plane was specially refitted as an airborne laboratory. The cosmonauts also flew on military fighter planes, made parachute jumps and busied themselves a great deal with physical training.

Within Star City the strenuous work had begun--thousands of hours of study, hundreds of special training sessions, flights, tests on the centrifuge and in the isolation chamber, fittings for space suits and many, many other things.

In the spring of 1961, two people were chosen from among those who were part of the first detachment: Yuriy Gagarin and his back-up man, German Titov. On 12 April, Yu. A. Gagarin completed the first space flight in the history of humanity. He showed that a person could live and work in space. And just a few months later--in August--G. S. Titov sucessfully completed a 24-hour-long

orbital space flight aboard the Vostok-2 ship. Space navigation had begun.

After the completion of the flight program for the Vostok ships, a scientific conference took place at the CTC, which summed up the initial results.

In 1963 a new group of cosmonauts began training at the CTC for space flights on the Voskhod ship and, at the insistence of S. P. Korolev, this group included not only pilot-cosmonauts, but also doctors, engineers and scientific workers. These ships differed from the Vostoks in that in the cabin there were work areas for two or three cosmonauts, and the descent vehicle of the spaceship landed with the crew members with the aid of a parachute. The CTC's specialists developed new crew training methodologies since the crew members did not all have the same physical training, had different levels of knowledge and differed from on another in their disposition and habits.

In January of 1963, a new group of pilots and engineers, having an abundance of flight experience, testing experience and research work experience, arrived at the CTC. This group was headed by V. A. Shatalov. After a year, G. T. Beregovoy was included in this group. They all completed a course of general space training for flights aboard the new Soyuz ships.

In connection with this, new study and training techniques were developed, in particular a complex simulator of a Soyuz ship. Star City grew as well. New living quarters were built, based on improved planning, along with production buildings and training laboratories, a swimming pool and a sports complex, and in the residential area there appeared a school, a kindergarten, a day nursery and a Palace of Culture. Star City was acquiring the look of a modern city.

In January of 1968, a group of cosmonauts, including Yu. A. Gagarin, had completed studies at the Air Force Engineering Academy imeni Professor N. K. Zhukovskiy. At the same time, the Earth's first cosmonaut continued to train intensively for a new space flight. But on 27 March, 1968, while on a training flight in a fighter plane, together with Hero of the Soviet Union Colonel V. S. Seregin , he died tragically. For Yuriy's friends, for all the inhabitants of Star City and for all the Soviet people this was a terrible loss.

SPACE BEGINS ON EARTH

The CTC, named after the first space traveler shortly after the death of Yu. A. Gagarin, is acquiring even greater fame, not only in our country, but also in foreign countries. Hundreds of delegations visit Star City. Leaders, socially prominent people, scientists and workers from many of the world's nations come here.

In 1971, our country observed the 10th anniversary of man's first flight into space. For its great services in the training of cosmonauts and in connection with this jubilee, the CTC imeni Yu. A. Gagarin was awarded the Order of Lenin.

Soon thereafter (1972) a full-scale model of the Salyut orbital station was assembled in the training hall.

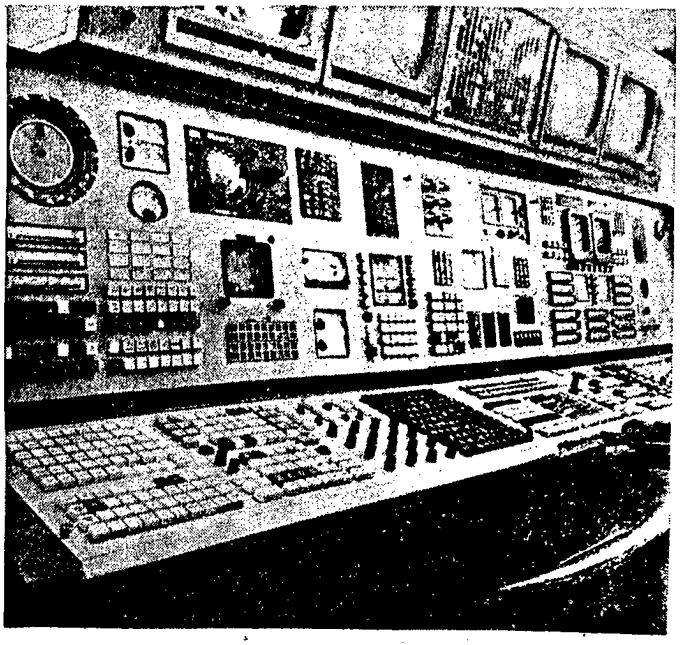

Fig. 3. This is how one of the control consoles in the Cosmonaut Training Center imeni Yu. A. Gagarin looks.

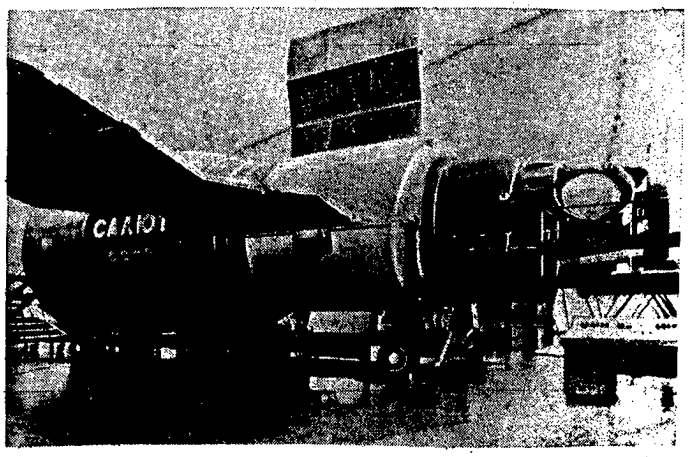

Fig. 4. The mock-up of the Salyut space station used by the cosmonauts to prepare for the prolonged orbital flights.

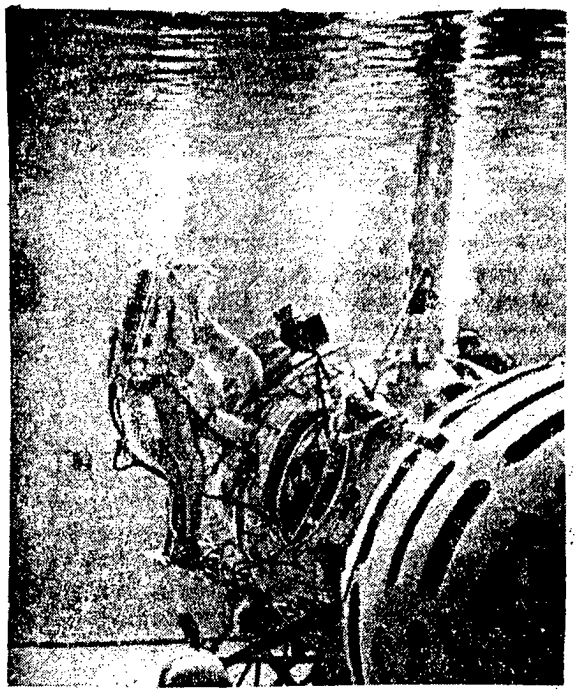

Fig. 5. The hydrolaboratory. Here the supportless condition typical of a space flight is simulated.

In 1975 Soviet cosmonauts attained new successes. Prolonged flights, lasting a month or longer, were begun aboard the orbital stations by Soviet crews.

The CTC was transformed into a mightly scientific organization, with all the necessary technical equipment for training a person for a space flight.

How the body of a cosmonaut bears up under heavy loads is ascertained with the aid of a centrifuge. Inside this rotating device the accelerations which arise when a spaceship is placed into orbit and when it descends to Earth are simulated. On one arm of the centrifuge there is assembled a cabin, into which the cosmonaut is placed (or several participants in the experiment at the same time).

Various tests are conducted in a hydrolaboratory--here there is a simulation in the hydrosphere of that supportless condition which is typical for a space flight. The base of the hydrolaboratory is made up of a tank basin. A model of the orbital station has been set up in it. Dressed in special suits, the cosmonauts carry out various tasks in the water, simulating an excursion into open space, including assembly and repair work on the external surface of the station. For safety reasons, along with the cosmonauts, there are scuba divers, dressed in lightweight diving suits, in the basin. The combination of training sessions in the hydrosphere and in the pressure chamber enables the the cosmonauts to acquire sufficiently solid work habits in the suits.

The future cosmonauts get acquainted with the conditions of weightlessness in the airborne laboratories--at the time of their flights along a parabola. The very same properties of weightlessness are created as occur later on during a space flight. In such training sessions the cosmonauts work with the suits and study how to position their bodies in space, how to orientate in various positions and poses and how to handle the scientific equipment.

For the training of the cosmonauts, for the systemic training sessions and for the successful completion of the individual tasks of a space flight, unique, complex and specialized simulators were created at the CTC: for example, the model of a ship cabin or station cabin with standard equipment, systems and sets, including crew work areas, as well as the necessary interior settings.

The complex simulator includes various space flight simulators. There are various types--television, electronic, electromechanical and others. Thus, the simulator of the external space conditions is a sphere of the ground surface. During the movement ("running") of the Earth, in the optical sighting device the cosmonauts can, with sufficient accuracy, visually determine the orientation of the ship in relation to the ground.

A complicated electromechanical device is the docking simulator. Control of the simulators, monitoring of the dynamic and logical operations carried out by the crew, the storage and processing of information and the solving of other tasks are accomplished reliably by a computer complex.

The full-scale models of the spaceship and the orbital station, equipped with

working instruments, systems and equipment, are also used for developing the interaction between the crew members, for strengthening skills in motion-picture filming, for developing conservation habits, for carrying out complex experiments and for many other things.

Video films play an important role in the cosmonauts' training. Drawings and diagrams are recorded on the videotape and, with the aid of the films, the functioning of various systems is explained--all of which makes it significantly easier to master the study material.

The terrestrial path of a cosmonaut to the cosmic heights is divided into two stages. First, there is a general or general-space training, which includes theoretical, technical, biomedical, flight, parachute and physical training. During this time the cosmonauts study the dynamics of flight, navigation, astronomy, computers, ballistics, medicine and space technology. They become acquainted with the launch complex and leave Star City to go to various scientific research institutions.

After completing the general training program studies, the cosmonauts take tests and examinations and are interviewed. Then they attend classes based on a special training program--for a specific flight as a member of a specific crew. At this stage the cosmonauts study the particular spaceship that they are supposed to fly in. They master the flight program and work out the functional responsibilities of the crew members (the ship's commander, the flight engineer, the researcher and the doctor). However, the basic type of training remains the training sessions on the various types of simulators, models and simulation test stands. Also continued are the flight, biomedical and physical training exercises.

Training sessions on a complex simulator, which simulates all the stages of the up-coming flight, continue until the entire program is completely mastered and the individual elements are mastered to the point of automatic reflex. Thus, while preparing for the first docking, Cosmonaut V. A. Shatalov carried out nearly 800 practice dockings on the simulator.

The final stage of the immediate pre-flight training of the cosmonauts is made up of all-inclusive (examination) complex training sessions, in which, not only the ship's crew members participate, but also all the other people who are to assist the planned flight--the groups of technical specialists from the Flight Control Center, the communications and tracking stations' operators and personnel form other service sections...

INTERNATIONAL CONTACTS

Within the CTC imeni Yu. A. Gagarin it is possible to meet not just Soviet cosmonauts. From 1972 through 1975, while preparing for the joint experiment in space in accordance with the Soyuz-Appolo program, American astronauts also trained here. It must be recalled that such training sessions were conducted on an alternating basis in both Star City and Houston--at the Americans' Johnson Astronaut Training Center [the Johnson Space Center].

At the end of 1976, the first group of cosmonaut candidates from socialist countries arrived at the CTC imeni Yu. A. Gagarin--two professional pilots each from the CSSR, Poland and the GDR, In 1978 three of them worked on board the Salyut-6 station together with Soviet cosmonauts in accordance with the Intercosmos program.

In the spring of 1978, representatives from Bulgaria, Hungary, Cuba, Mongolia and Romania arrived, and in 1979--from Vietnam. Working as cosmonaut-researchers, they successfully worked in orbit from 1979 through 1981. These international space flights yielded a lot of valuable information for the scientists from the socialist countries. And in 1983 and 1984 representatives from India and France visited space.

The CTC imeni Yu. A. Gagarin today has available everything necessary for successfully training cosmonauts for new launches and for prolonged work on board orbital space stations.

Thousands of our fellow citizens and visitors from various nations visit Star City every year. And, of course, they pay homage to the planet's first cosmonaut--Yuriy Alekseyevich Gagarin. At any time of the year fresh bouquets of flowers can be found at the Gagarin Monument.

Exhibits in Star City's Palace of Culture reflect the entire history of manned space flight. Also here are gifts from the workers of our country, as well as from many countries of the world--evidence of the sincere respect and love for the Soviet man who dared to ascend into unexplored space. Here the personal effects of the Earth's first cosmonaut are preserved.

Attention should also be turned to such a gratifying fact as that many cosmonauts, after returning to Earth, have continued serious studies in science and have defended dissertations--the names of cosmonauts who have become scientists are K. P. Feoktistov, B. B. Yegorov, A. S. Yeliseyev, V. N. Kubasov, N. N. Rukavishnikov, G. M. Grechko, Yu. N. Glazkov and others--are well-known to all.

The living quarters and office spaces of Star City are splendid and the simulators and sports complex are unique, but, undoubtedly, Star City is particularly proud of its own cosmonauts and the CTC's specialists. They, the scientists, pilots, methodologists, engineers, instructors, doctors, communists and Komsomol members, are entrusted with the leading edge of science, from whence the thorny, but beautiful road into space begins.

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EXCERPTS FROM COSMONAUT SAVINYKH'S FLIGHT DIARY

Moscow PRAVDA in Russian, 29 Dec 85, pp 3, 6

[Article by A. Tarasov, PRAVDA special correspondent, under the rubric "Around the Nation of the Soviets," excerpting entries from the flight diary of Viktor Savinykh, twice Hero of the Soviet Union and pilot-cosmonaut of the USSR, "If I fly again..."; source introduction printed in boldface]

[Text] This is how it is. Viktor Savinykh could have greeted this new year with his flight comrades on board the Salyut-7 station--and yearned for home, for his relatives and for the Earth.

But he is celebrating the holiday at home and yearning for the Salyut-7 station.

It is not for us to judge which sadness is "sadder." But we can and should understand a basic law of this difficult profession: in space a cosmonaut does not have enough of the Earth and on Earth he does not have enough of space.

Viktor has in his hands a thick notebook, filled with dark lines from one brown cover to the other. It is impossible to believe that it is feasible to fulfill this chronicler's duty so persistently and systematically under conditions of weightlessness that are so unstable for letter writing and in that continuous orbital wheel.

Yes, this is his flight diary, his compressed chronicle, a summary of the thoughts and feelings which arise in the alternation of space days and nights. In accordance with a pre-launch agreement with PRAVDA, Viktor Savinykh has allowed us to publish pages of this diary, having supplemented them with reflections on the difficult space orbits. The story about the expedition was begun in the 8 October edition of our paper by the commander of the "Pamiry," Vladimir Dzhanibekov. Today we continue with the words of his comrade, the flight engineer of two crews (and the commander of the "Chegety" in the final stage), Viktor Savinykh.

The reader will note that both stories are simple in their presentation, avoiding "high style," especially such words as "great feats" and "heroism." But we know that what is being discussed are great feats of the very highest standards--the feats of our contemporaries.

"Today is the first time I have managed to write a few words. Inside the station it is cold, the viewports have frost on them, like windows in wintertime in the country. There is frost on the metal parts, near the hull. We sleep in the living quarters compartment of the ship in sleeping bags, it is not cold there. We work in warm overalls and down hats borrowed from home. Our feet freeze in our flight boots and so do our hands if we don't have any gloves on. Within the station it is quiet and dark. We work in the light and at night we use lamps. Our health is good. Hope has emerged."

Such is the first notation in the diary. It was made on 10 June, on the 5th day of the flight and the 3rd day of operations in the station. Much has, of course, already been written and said about what preceded this moment. Mention has been made about the division into optimists and pessimists prior to our launch. Of course, the specialists presumed various things and had various expectations regarding the condition of the Salyut station. But it must be noted that all the cosmonauts agreed firmly on one set of ideas: that it was necessary to make the flight, that it was necessary to dock and that it was necessary to save the station.

With a feeling of regret I parted with the crew preparing for the flight--with Vladimir Vasyutin and Aleksandr Volkov. Over the months of training we had gotten used to one another, had achieved harmony in our work and had already envisaged ourselves on board the Salyut station. I was consoled only by the fact that I had the opportunity to work with such a first-rate expert and wonderful person as Vladimir Dzhanibekov, and by the fact that the task was really unusual--both in complexity and in responsibility. Finally, in the event we were successful in restoring the station, I would return again as a member of the "Chegety" crew. Thus, the separation was conditional.

Training sessions on the simulators of the ship and the station and the search, together with the specialists, for methods and algorithms for approaching the Salyut station, tests, thousands of pages of documentation, dozens of variations of actions covering non-standard situations... Yet, even on the last day before the flight to Baykonur--defending a dissertation at the science council of my own Moscow Institute of Engineers of Geodesy, Aerial Photography and Cartography. Although the institute is my own, the last night I had to sit at home, until 5 o'clock in the morning, poring over instruction sheets, references and essays. I really did not want to disgrace myself and at the oral session I was as nervous as a schoolboy, as if one of the new optical devices being defended in my dissertation was not already flying in orbit.

In brief, after all this hectic time even the very decisive moment of docking and transferring to the station seemed much more calm. We formed up like a precise and well-trained relay team, with exceptionally well-coordinated interaction between the automated mechanisms and the people. In general, the work

of the specialists during this flight was worthy of the highest possible praise. Whether daytime or nighttime, we could get an answer to any type of question right away and decisions were made authoritatively right then and there, where previously it would take days to get a collection of signatures for an agreement. Thus, for everyone the restoration of the station served as a school for a new method of operating.

"11 June. We turned on the lights at the first post and how it made a difference in living conditions. And in the evening we even warmed up some canned goods and bread and dined on a hot meal. A Holiday! Today we spent almost the entire day in the station and by evening we were quite frozen. Volodya's feet were warmed up by the heaters which had warmed up by dinnertime. We did not look at the Earth. Again a complete overhaul, but much more complicated. The lifeless station is slowly coming back to life."

Yes, we tried a hot meal for the first time already a week after our launch.

Finally, the quietness of our "carriage" stopped being so oppressive. The first live sound we heard was the noise of the drive for the solar batteries. I stood (or more accurately, hung) opposite the 10th viewport, looking at the 4th plane. The reduction gear began to make a noise, the plane deployed and life began.

The clocks and the "Globus" began ticking and the ventilators started making a sucking noise. Without them it was recommended to us that there not be two people in the work compartment at the same time. We could exhale around ourselves such a cloud of CO_2 that it would then be impossible to breathe. But, in fact, it is not possible to sit in separate compartments all the time. In order not to make the ground nervous we said we were separated but, in actual fact, of course, we were working together, dispersing the clouds around ourselves, each using his own primitive method.

Our subsequent life also took shape. Exposed panels on the walls and ceiling, a huge number of hoses and cables strung out along the entire length of the station, an endless search for the needed connectors, their attachment and detachment in order to check the instruments and equipment.

"13 June. Ryumin basically handles the communications all the time. He sets the tone in our work."

"16 June. Today we covered several panels already. We are living without hot water. Yesterday it turned out that the water heater was not operating. We defrosted it. The system was not designed for below zero temperatures. For this reason we are filling the milk packets with cold water and heating them using the "filming light" lamp. It gives off qite a bit of warmth and soon we were drinking slightly warmed up milk. Today we performed exercises for the first time. I worked on the veloergometer [bicycle exerciser]. My pulse after the strain was not high, nearly 100. I tried running barefoot on the treadmill. Everything is fine and my legs do not hurt..."

On the previous station, the Salyut-6, it was possible to transfer the TV set

onto the wall in front of the treadmill. And run to your heart's content, even for hours, watching a recording of a concert or a movie. On "7" such a rearrangement became impossible and more's the pity. Running while staring stupidly at the wall in front of you is not one of the more pleasant occupations. But it is necessary, there is no place else to go. And Volodya Dzhanibekov sets the example, beginning his exercises with this less pleasant procedure. He tries to do everthing that is less pleasant at the beginning, saying that this developes willpower.

In general, he feels certain that there are no unfulfillable tasks and no hopeless situations. Unhurried, short-spoken, without "nerves" during any kind of puzzle and in any kind of time squeeze, the commander has a good understanding of radio equipment and electronics and can untangle any kind of puzzle in a circuit. He has the hands of a genuine expert. And no matter what he is doing, he will come scurrying over to see how you are doing and how he can help you.

The only sad thing is that he did not have much time to spend on his favorite pastime, drawing. There is never any spare time and the situation or model outside the viewport change very quickly and for such a thing it is necessary to concentrate closely and to get in the proper mood. Sometimes in the evening I would lay down to sleep and he would go off into the PKhO [transfercompartment] with his album and pencils. He would return around 12 o'clock, somewhat melancholic. "Did you draw something?" "No, nothing turned out... I took a few photos..."

"17 June. Already we are beginning to slowly make ourselves at home, even in our daily routine. First thing in the morning I shave and brush my teeth with a glove impregnated with sage. I wash off, rubbing my face with a napkin. Whenever I go through this procedure I imagine that it is morning, a well in the country, a bucket of water and you pour water from the ladle into your hands and bring them up to your face..."

It was not without reason that the cold well water came to mind. Just at that time there was "tension" regarding the on-board water. Actually, the reserve was adequate--200 liters just in one of the station's tanks and a little bit less in the other. But at the time of our arrival this reserve was not water, but ice. Ice, of course, as is well known, will not flow through pipes.

Later, after I had returned, I heard that on the ground, in the Flight Control Center, this situation had been felt very keenly. There had even been consideration of the question of our return, "just in case." We did not perceive this deficiency with such acuteness. We reduced our daily expenditure and orientated the station's tank (the one with the smaller iceberg) towards the Sun, knowing that at the cosmodrome our comrades were urgently preparing to launch a supply ship with new reserves, instruments, spare parts and assemblies. We were already prepared to put up with a lot--but there was never any thought about leaving the station. Indeed, the long-awaited day for changing over to the scientific program had arrived. Repairs just for the sake of repairs would not have led to such expenditures of effort on Earth or in orbit.

"22 June. In the morning we were supposed to take photos in accordance with

the "Kursk-85" program, but once again cloudiness did not allow this. And at the next session our wives came into the Flight Control Center. We missed their voices and those of the children. For two sessions the conversation concerned matters on Earth. My daughter still has one exam left--physics. And the Graduation Ball is already scheduled for the 26th. The time had come to say goodbye to school. For me these years had sped by completely unnoticed, they had been devoted to preparations for flights..."

There is one term that is closely connected with cosmonautics: psychological support. Sometimes the specialists in this field have been puzzled as to why I show such passive concern regarding the selection of artists for concert programs on board the station. And not just me alone. But we did not get together up there to harass people with our own whims in connection with favorite or disliked performers. We are grateful to everyone who comes to Ostankino to share their lively words and songs. The main support lies in how things are going. You solve the latest problem--and you are literally flying on wings .

I remember a lot of things, at times even things not very notable to another person, with gratitude. The arrival of Vladimir Kovalenko at the institute to defend my dissertation. A film with a farewell recording of the great pilot, Ivan Kozhedub, prepared before the journey by the fellows from the radio industry. A twig of absinth placed in the on-board journal by Aleksey Leonov. A professional conversation with an intelligent, precise and composed specialist who understands you. I would like to mention Stanislav Andreyevich Savchenko, the developer of many astrophysical and geophysical programs. At such a great distance he can sense with amazing accuracy how you are working with an instrument, at which star a viewport is looking and what your mood is in general. Or a conversation on sailing with the famous trainer and teacher, Sergey Mikhaylovich Voytsekhovskiy, and with world-recordholder Volodya Salnikov. We discussed with them not only the secrets of sports mastery, but also the design of possible training simulators, for example, a rowing machine, to supplement adequately and suitably our on-board equipment... The festive meetings with cosmonauts from fraternal countries-- Gurragcha , Germashevskiy, Jehn , Prunariu, Mendez. The voices of our fellows--Volodya Solovyev, Lenya Popov, Sasha Aleksandrov, Svetlana Savitskaya and all the others. You can note how the mood improves after all these things, as does productivity.

"25 June. Yesterday we were so tired I had neither the strength nor the time to write. I hardly got out of the supply ship. We changed out the water heater, flooded it with water, thoroughly washed out all the hoses and were soon drinking tea. After our exercises we had three packets of tea with milk. What a story!"

"Now the station resembles a train depot: packages, sacks, assemblies, containers of food. All this stuff that arrived and such excessive quantities. It forms an obstruction. Equipment arrived for going outside--we are beginning to put the stuff up and check it."

Regarding dreams. For some reason the most frequent and most alarming dream is a search for some kind of hose or connector. You look and look but you just can't seem to find it...

"26 June. I had a headache this morning. Apparently there is poor ventilation in the sleeping area since everything is heaped up in there. I took some Analgin and it went away. Today I extended the air pipe."

"7 July. My day off was spent giving urgent attention to my eyes. I woke up at 3 o'clock in the morning because of some incomprehensible sensation. My eyes were irritated and there were tears, I could not open them, they were stinging. Then I understood what the problem was. I had experienced this on Earth in 1975 after having watched a welding operation at a construction site for too long. The sensations were identical. I had, apparently, looked too long at the non-setting Sun in the 14th viewport, which had let ultraviolet radiation in. I scrambled out of the sack, boiled some tea, made a tea dressing from a napkin and so "hung" at the table like that for half an hour. Things got a bit better..."

"17 July. There are occasional moments when there is time to talk a little about your family, your home and your school. Little by little we get to know things about each other that we hadn't known before. These conversation basically take place at breakfast, lunch and dinner, when we "hang" at the table, facing one another. So far we have not once sat down to eat without everyone being there. Thus, today at lunch the conversation concerned the difficulty of our business, the loneliness and our return to Earth. We are alike in one respect: 40 days have passed already, but there is no depression, no feeling of loneliness or of remoteness from home, the ground or relatives... I don't know what will happen to me when Volodya leaves."

"27 July. ...For two sessions we watched the Moscow Festival on the screen. The picture was excellent and the weather did not let us down. Two festival participants, absent for a valid reason (as they said on the television), ensured the weather."

Now it was necessary to ensure the "weather" on the station as well. And to do this it was necessary to go out into space and build up the third solar battery. The preparations for the excursion were more complicated than usual. During the check-out my suit turned out to be non-hermetic. We looked and looked and we found where it was hissing. It turned out that in weightlessness one small strap from inside had gotten into the joint for closing the knapsack. It was necessary to shorten it. Additional time was spent on all this. A note recalls: "1 August was a day off, but we spent the whole day on preparations."

Finally, my first excursion into open space.

"2 August. The hatch opened without any special effort required. When I opened it, there immmediately flew "into the door" all the rubbish that was in the PKhO: every possible kind of scrap, strings, small pieces of porolon and dust which shone clearly in the rays of the Sun. I immediately 'anchored' myself. The beauty of the Earth startled me, as did black space and the station itself. It seemed somehow very large, hugh... Until the shadow we set up the container and undid the latches. In the shadow we removed the container and opened up one battery. The shadow was from the moon and there were also the lamps which had been installed on the new suit's helmet and which illuminated the

work site so well. Then it was necesary to deploy the entire battery in order to position the other 'side.' And this was possible only on a command from the ground in the Yevpatoriya zone. So, for 20 minutes we had the opportunity to look at the Earth while waiting to enter the zone."

"While the deployment was going on, we joked cheerfully with the ground. But, once the battery had been deployed, the joking ended. Somewhere a line jammed. At first we thought the problem was in the winch, which I had been turning. Volodya took my place and tried, but the effort was in vain. At this time our 'pokers' floated away, as did the additional handrail. Apparently, while we were changing places, they had come loose. The situation was complicated. To turn back was impossible--the additional battery was needed. We now understood that the problem was not in the winch. Volodya moved a little farther towards the hatch with the end of the rope in his hand. He jerked it sharply and I jerked the lever of the winch, trying to move the rope from its place. After several jerks the rope moved. Hurrah! Slowly, with a great deal of effort, I turned the winch, but this no longer had any importance. We had coped. My arms were already turning poorly at the wrists, they were tired... We were in space for 5 hours exactly. But we were dry when we took off our suits--the temperature control system had operated very effectively. On our arms there were traces of pinching. It stabs the arms. This persisted for a long time. We dined and drank hot coffee with lemon. Our mood is cheerful, but our fingers are tingling . I took a tablet and went to sleep. Our fingers tingled for two days. Especially the little fingers."

The additional power enabled us to be more active in scientific tasks.

"7 August. New work has come, new expectations. We completed two zones of geophysical photos. Today I saw the mouth of the Vyatka distinctly and photographed it. I made several photos of the innumerable roads on the steppe beyond the Volga and the Urals. We see traces of negligence...."

"12 August. A communications session was held and I watched the clock, and such is the picture I saw. My mother in a bright rural cottage and guests gathering. Today is my daughter's birthday. Grandmother has pirogies. And our work proceeded, the day is going excellently."

"14 August. We conducted an experiment in accordance with the line of the GKNT for the purpose of determining the pollution of the atmosphere of cities. We worked in the Zaporozhye area. Good orientators, we had previously set the gyroscopes and were accurate and then we kept it in the field of vision of all the equipment: the MKF-6, the MKS-M and the rest..."

"15 September. We are frequently asked about cheerful situations in space. In general, they don't exist. But today we were amused about the fact that I flew up towards the ceiling in my armchair at dinner, having pushed off from the canned goods store, into which I had crammed a milk packet. The chair unfastened from the floor and I flew up together with it towards the ceiling..."

Shortly after the arrival of the "Chegety" Volodya's mood began to deteriorate. His departure from the station was approaching. And the work just went on. It

seemed that 100 days were a lot, but they flew away--like a single day. But on the other hand, there was the joy of meeting up with our fellows, the letters, the news and a very interesting program we had earlier discussed with Grechko on the ground.

"19 September. I got up first, at 8 o'clock. When I flew to the first station, Grechko woke up and grabbed me by the leg, asking about the time. Gradually everybody began to get up. I had already prepared the hot water and the food containers had been warmed up. The fellows are not bad sorts. Volodya didn't have any appetite. Dzhan slept in the PKhO and said he had slept well, and I gave up my own place to Vasyutin. There was a pleasant bustle around the table. The fellows are mastering all this science--how to wash, how to shave and the like. For the first time these things are not simple."

The week of joint work was basically devoted to the Earth's atmosphere. The conductors for this program were Savchenko on the ground and Grechko in space. The harmonious operation of a good 10 surveying instruments required an optimum effort. At home we had not gone through all this in such a group and we had to develop new habits in the air. In our eyes is a picture, for example, of a hunt for the Sun. Sasha Volkov is at the viewport with binoculars--he is supposed to project the setting luminary on a screen. Grechko and I are hanging at the ceiling and getting ready to photograph on this screen the aerosol layers the Sun reveals during its passage through the atmosphere and Dzhanibekov is keeping track of another viewport where a homemade coronograph has been installed in order to photograph it. Even Volodya Vasyutin has been torn away from the biotechnological device, the "EFU-robot," with which he basically occupies himself, in order to record the time. The preparations take an hour or maybe more than an hour. The photographs take half a minute. And then it is necessary to switch to some other star that is also plunging into the atmosphere.

Flight veterans sleep about 3-4 hours a day. On this basis I will still sleep well on subsequent flight, whereas Dzhanibekov and Grechko will soon make up for lost sleep on the ground.

To say goodbye was probably easier for me than for "Pamir-1." I was remaining in orbit, ahead was a pile of work and the station was in fine form. Volodya wanted very much to stay and work some more. I sympathized with him with all my heart, but...

"25 September. The farewell was repeated several times--for the movies, for the TV and then for ourselves. At 2:30 they closed the hatch behind them. Volodya and I had worked well together. During the farewell I had wanted to say something special, but everything turned out simple and we did not manage to talk about our business and about our relationship with one another. I sent home letters, envelopes and gloves I had worn in space."

I could not know at that moment that I would soon experience a feeling more similar to what Dzhanibekov felt. The station is fully operational and ahead is a complex program using interesting equipment. And the fellows were starting to really get the hang of things and were asking what and where less and less

frequently. Vasyutin was getting a more and more confident feeling about the "controls" of the station and Volkov studied all its nooks and crannies and could be very helpful spending time with a soldering iron and a tester over some circuit or at an inaccessible joint. The large supply ship "Cosmos-1686" arrived. Just work and work some more. But...

It began when we noticed a slight uneasiness in Volodya Vasyutin's behavior. He was losing sleep and his appetite. We thought that the problem was in his frame of mind--this happens to everyone. We tried to bolster it with jokes and advice. But pain appeared. Volodya wanted to hang in there, but it was becoming more and more difficult for him.

"28 October. Well, today was the day. The work went on and we did everything, but I watched Volodya--he was miserable. Everything was tense and he was a bundle of nerves. In the evening, at dinner, for the umpteenth time, but this time firmly, I said it was time to consult with the ground. Sanya backed me up. Volodya no longer objected at all. For him to talk with the ground was, of course, difficult. It was possible to understand his condition. The session ended. For a long time we did not lay down to sleep, calming him down. We practically didn't sleep the whole night. The next day, the specialists, including Academician O. G. Gazenko, supplied all the necessary recommendations for treatment. Volodya's mood improved..."

"2 November. November has begun. In all probability it will be a most difficult month. We will let Volodya rest in the sack and Sasha and I will carry out the program..."

"7 November. I got up earlier than the other fellows for the first session. I listened to congratulatory telegrams. While the fellows were sleeping, I prepared a 'Holiday Breakfast.' Today is a holiday on our Earth and that means for us as well, since we are a small part of our Homeland, which made all this equipment and entrusted it to us to work on. This is a very great trust. And a hugh responsibility which lies on us..."

"18 November. I didn't want to write yesterday or today either. Yesterday the decision was made regarding a landing. We were given 3 days for preparations..."

During this time it seemed to us and to the doctors and to Volodya himself, that his health was improving. Sasha and I were ready to ensure him complete rest and to carry out the program. And all the same, the decision was correct. Each of us can and has a right to risk our own health--but only our own. The health of a comrade can not be subjected to any kind of risk. This is a law of our cosmonautics.

I really did not want to leave the station while we still had the inclination and the strength to work. But, instead, we had to turn and twist the dozens of bolts on the Salyut and Cosmos crafts for the last time, to turn off the instruments and to cover the viewports.

"28 November. I turned off the lights everywhere and swam into the PRK, where the others already were. On the table we left a note for those who will come after us. That's everything, au revoir, Salyut-7. I left a lot of my things there, so that if I fly again, there will be something to put on..."

NEW RADIO-OPTICAL TELESCOPE COMPLETED AT YEREVAN

Yerevan KOMMUNIST in Russian 23 Feb 86 p 3

[Article in "Along Routes of the Scientific and Technical Revolution" section, by B. Musayelyan: "The Time of Large Antennas"]

[Text] It was misty and gloomy in Yerevan, but here the skies were like a blue expanse, probably because we had climbed 1800 meters closer to them, and the snow glittered and gleamed. The graceful outlines of the antennas of the State Standard Center for Antenna Measurements (GETsAI) of the All-Union Scientific Research Institute of Radiophysical Measurements (VNIIRI) blended into this magnificent snow-cover background.

There are more and more antennas here every year. They are unique--standards in relation to whose characteristics other domestic antennas are certified.

And there is the pride and joy of GETsAI--the largest antenna with the diameter of the main spherical reflector measuring 54 meters. It really deserves a poetic name, but for the time being it is officially called RT-32/54. A radio-optical telescope. The decisive element of this unique instrument--the antenna--has been implemented according to a new system different from existing ones.

Now, when the antenna is finished, many of the engineering solutions found appear simple and comprehensible. But the road to them was not easy.

The antenna was tested for the first time, still in unfinished form, in June of last year. And immediately it registered a rare phenomenon--a powerful burst of radio-emission intensity in the star Etta of the constellation Gemini, located at a distance of 250,000 light years from us. A radio burst was recorded for the first time in stars of this type--red giants.

Visible light is in the form of electromagnetic waves of various lengths, perceived by the eye as color from violet to red. On the electromagnetic wave scale they are part of the so-called optical band. Beyond the optical band, in the direction of an increase in wavelength, is the infrared, and then an enormous band of electromagnetic waves called radio waves.

For many centuries people studied the surrounding stellar universe from information arriving in the optical band, i.e., from light arriving, visible to the eye. Only a few decades ago did they begin to register also radio waves arriving from outer space. This led to many new and interesting discoveries and expanded and deepened knowledge of the universe. Scientists discovered radio galaxies, radio emission of interstellar gas, pulsars and quasars. But in order to receive the weak radio emission of far-off objects large receiving antennas were needed.

"It is necessary to build a high-precision large antenna," asserted the young radio engineer Paris Geruni at the end of the 50's, who headed the radiophysical design bureau at the Byurakan Astrophysical Observatory of the republic's academy of sciences.

Already in operation by that time was the 76-meter English antenna at Jodrell Bank Radio Observatory, and large antennas had been designed in other countries, too. Geruni knew about the shortcomings of these antennas and decided to "modify" the classical version of their construction by finding another solution. High precision and sharpness of the beam in space can be achieved only with a fixed main reflector of spherical shape. The idea was supported by Academician V.A. Ambartsumyan. The labor-intensive calculations were performed at the design bureau (several people worked at it at that time) first by means of calculating machines and then by one of the first "Nairi" computers. An operative 5-meter model of the antenna which had been constructed confirmed the originality of the project and the promise of the design.

The difficult, lengthy period of corroborating the antenna's design began. Its calculated dimensions, high precision and low price level proposed by Geruni even now astonish the most fervent imagination. But 20 years ago the venture seemed more than audacious.

The opponents became an obstacle. It seemed that all was lost and it would be necessary to give up the dream. Geruni indefatigably proved the correctness of the scientific conception. But for the purpose of implementing it, it was necessary to travel the long and difficult road of creating an institute, a plant and GETsAI.

Construction of a 54-meter antenna having precision of greater than one tenth of a millimeter (!) began already when Paris Misakovich, now a corresponding member of the republic's academy of sciences, became director of VNIIRI and head designer. A great number of problems and very complicated tasks immediately arose.

It was necessary to develop more than 50,000 cubic meters of rock; to place more than 12,000 cubic meters of reinforced concrete in a spherical concrete bed for an antenna the height of a 10-story building; to fabricate and assemble at a high elevation hundreds of tons of metal structures; to cast and machine panel elements for the main reflector with a total weight of 600 tons; to fabricate and assemble multi-ton and high-precision scanner assemblies, complicated systems of digital servo drives, high-sensitivity radio receivers for weak signals; and much, much more.

Now all of this is behind. The team of the institute and its pilot plant has truly done a titanic job.

A great, difficult and very important part of it was done by a highly experienced worker--Caster G. Utundzhyan and comrades. They were able to pour all 3800 high-quality Duralumin panels for the main reflector. Seeing the cast articles, highly placed guests of the institute more than once have expressed admiration for 75-year-old Varpet Grigor's art.

A valuable contribution to the development of the antenna and the entire complex of buildings and facilities at GETsAI was made by the residents of the neighboring settlement of Orgov, which had been threatened with liquidation. Because of the construction, it received a road, water, light and work and was rebuilt all over again and fluorished. Skilled craftsmen in many fields of specialization now live here and work at GETsAI.

The development of unique large items requires from their developers an exertion of effort, enormous self-sacrifice and a creative quest. After all, each part and the entire composition must work as intended. Not a few original solutions were found in the process of the quest. Here is one of them. For the purpose of gathering rays (radio waves) reflected from the stationary main reflector, a secondary reflector (five meters in diameter and weighing 15 tons) fastened to a supporting tripod must pivot above it on hinges. It was decided to place on the other side of the hinge as a counterweight one more reflector, but now for an optical telescope, 2.6 meters in diameter. Thus, the instrument at the same time gained the ability to operate in both the optical and radio bands. This case is the first in world practice and is as yet unique.

The antenna for the new radio telescope is the most precise of all large antennas in the world. Therefore, it can operate with short radio waves about 1 mm long and can form in space a record-sharp beam. And this will make it possible to "make out" fine details of distant galaxies and to study other stellar universes and the state of matter at enormous distances. Finally, the antenna developed will become a national standard for the purpose of ensuring the unity and high precision of measurements of the parameters of large radio telescopes and earth systems for space communications.

The State commission's document for the completion of the construction and installation work has been signed. The evaluation is "excellent." But the new powerful instrument is a valuable contribution to the country's scientific and technical potential.

8831
CSO: 1866/95

CRIMEAN ASTROPHYSICAL OBSERVATORY'S GAMMA TELESCOPE AND ASSOCIATED RESEARCH

Moscow ZEMLYA I VSELENNAYA in Russian No 5, Sep-Oct 85, pp 64-67

[Article by A. A. Stepanyan, doctor of physical and mathematical sciences, under the rubric "Observatories and Institutes": "The Crimean Astrophysical Observatory's Gamma Telescope," source introduction printed in boldface]

> [Text] Over the past 4 decades astronomy has been transformed from a purely optical science into an all-wave science. And now its observation range extends from the gamma range to the radio-frequency range.

For more than 15 years now searches have been conducted at the Crimean Astrophysical Observatory [CAO] for sources of gamma quantums with energy on the level of 10^{11-12} eV. The gamma quantums arise during the interaction of cosmic rays, which are high-energy particles, with matter or with an electromagnetic field. More favorable conditions for the generation of gamma quantums are created where there is a HIGH DENSITY OF HIGH-ENERGY PARTICLES AND MATTER. Thus, the search for and investigation of gamma quantums of ultra-high energy pursue a dual goal. On the one hand, WHERE THEY ARE BEING GENERATED is being clarified, that is, the question about the sources of high-energy particles is being solved. On the other hand, the investigation of the special features of gamma quantum streams is yielding an opportunity to study the PHYSICAL CONDITIONS on those objects, where the generation of cosmic rays is occurring.

Astrophysical research using gamma astronomy methods is extremely complicated. First, the streams of gamma quantums are EXTRAORDINARILY WEAK. For example, the stream of gamma quantums of ultra-high energy from the most powerful source, Cygnus X-3, amounts to only a few quantums per square kilometer per second. Second, the measurement is hindered by the large number of charged particles of high energy which make up the BACKGROUND of cosmic rays. Nevertheless, in recent years, thanks to the successes of gamma astronomy, an opportunity has emerged for answering several questions associated with the generation of cosmic rays. Thus, it is clear by now that the generation of high-energy particles is occuring in pulsars (for example, ones such as the pulsar in the Crab Nebula and the pulsar in Vela), in the two x-ray systems (Cygnus X-3 and Hercules X-1), in radio galaxies (Centaurus A) and quasars (3C 273). Data has been obtained for several objects on the nature of the variability of radiation.

It is well known that gamma radiation of high energy ($E_{кв} \sim 10^8$ eV) and ultra-high energy ($E_{кв} \sim 10^{12}$ eV) from pulsars changes with the same frequency as radio-frequency radiation. Radiation from the two x-ray systems, Cygnus X-3 and Hercules X-1, is also of a periodic nature. But, inasmuch as the streams of gamma quantums are very weak, unfortunately, it has not been possible to study their temporal characteristics in greater detail.

In 1974 work was begun at the CAO on setting up a new type of telescope system for the recording of gamma quantums of ultra-high energy.

But before discussing the new set-up, it is necessary to discuss, even though briefly, what equipment is used for recording gamma quantums of ultra-high energy. We have already mentioned previously that the streams of gamma quantums are extremely weak. As early as 1960, Soviet scientists G. T. Latsepin and A. Ye. Chudakov had turned their attention to the possibility of using the Cerenkov glow of extended air showers to search for discrete gamma radiation sources.

The main thing is that when a gamma quantum of ultra-high energy enters the Earth's atmosphere it interacts with the nuclei of atoms of air and forms a pair of particles--an electron and a positron, to which the quantum transfers all of its own energy. These particles interact in turn during their movement with atoms of air, forming gamma quantums and transferring part of their energy to them. It is easy to understand that conditions are created for forming an electron-photon shower, in which the number of particles grows in accordance with its degree of penetration into the atmosphere. This process continues as long as the electrons have not yet begun to lose the main portion of their energy due to the ionization of the atoms of air. When the energy of the original particle is 10^{12} eV, the maximum number of particles (about 1000) is at an altitude of 6-8 km above sea level, and, for all practical purposes, the particles do not reach the Earth's surface because they lose their energy due to the ionization of the atoms of the atmosphere. Fortunately, particles possessing a sufficiently large amount of energy (more than 35 MeV) radiate a Cerenkov glow in the longwave optical range. This makes it possible for us to record the gamma quantums.

Such a glow occurs during the movement of a particle in a medium with a speed greater than the speed of light diffusion in the given medium. If the particle possesses energy much greater than its phase potential energy then its speed becomes extremely close to the speed of light in a vacuum and exceeds the speed of light diffusion in the air, which at altitudes of 6-8 km differs from the speed of light by less than 0.1 percent.

Cerenkov radiation in the atmosphere is narrowly oriented. Thus, when a gamma quantum of ultra-high energy enters a circle with a radius of 100-200 meters, it is possible at the Earth's surface to observe the Cerenkov radiation in the visible and ultraviolet ranges of optical radiation. The duration of this flash is extremely small--several billionths of a second. The result is that, in order to observe the gamma quantums, it is necessary to build a telescope and to record the brief light flashes in the sky. If you were to look from the ground, then the angular size of this flash would be very small, approximately 1 degree.

The recording itself of such flashes does not present any kind of serious problem: to do this it is sufficient to take a large mirror (~1-10 meters) and place a photomultiplier at its focal point. By using modern electronics it is possible to count the number of flashes that enter the telescope's field of vision.

But, as has already been mentioned, the matter is complicated substantially by the background of cosmic rays. It turns out that during entry into the atmosphere high-energy particles (that is, cosmic rays) also form a large number of electrons and positrons. The only difference is that the resultant electron-photon showers arise mainly as by-products of the decay of neutral mesons formed during the nuclear interactions. For this reason simple telescopes can not distinguish between Cerenkov flashes caused by gamma quantums and those caused by cosmic ray particles. The only thing that helps is the fact that the magnetic fields of the interstellar medium do a good job of "muddling" the direction of movement of the charged particles and their stream, to a high degree, turns out to be ISOTROPIC. In order to identify the gamma quantum stream, it is necessary to compare the number of Cerenkov flashes comming from a specific astrophysical object with the number of flashes in adjacent directions. Because of statistical fluctuations in the number of events (and the number of recorded flashes ~1 second^{-1}) and because of the faintness of the stream, a lot of time is spent on this. Obviously, for the recording of the Cerenkov flashes, it is necessary to have clear nights. And, what's more, when the moon is shining, it is likewise impossible to make observations, inasmuch as the glow of the night sky leads to "illumination" of the photomultipliers.

Experience has shown that, for reliable detection of a gamma quantum stream from a specific source, it is necessary to observe it OVER THE COURSE OF SEVERAL YEARS. But, if you learn to differentiate between Cerenkov flashes caused by charged particles of cosmic rays and those caused by gamma quantums, then the time needed for locating and investigating a source of ultra-high-energy gamma quantums is greatly reduced. With this goal in mind, a gamma telescope for recording Cerenkov flashes is being set up at the CAO. The main difference between it and other gamma telescopes is that it permits the composition of a Cerenkov flash image in the focal plane. To this end a mosaic of photomultipliers is being place within the focal plane of the telescope. The light signal from the Cerenkov flash is transformed into an electronic one. Knowing the magnitude of the signal in each photomultiplier, it is possible to compose a flash image. And using such an image, it is now possible to attempt to determine what caused the flash: a proton or a gamma quantum. The fact is that, in conformity with calculations, the average angular size of the flash caused by a proton is larger than that of one caused by a gamma quantum. This task is not simple, since the differences are not that great. The principal difficulty is the fact that there exist significant fluctuations in the sizes and shapes of flashes--both of ones generated by protons and those generated by gamma quantums.

The CAO's gamma telescope consists of two identical sections. This permits not only a twofold increase in the mirror area for reception of Cerenkov radiation, but also a more efficient use of them for solving various problems. For example, one section can be turned towards a presumed source, while, at the

same time, the other can be used to record Cerenkov flashes in an adjacent direction.

In turn, each section consists of six identical telescopes. Such a large degree of division is not associated solely with the technical aspect of the matter. In the U.S., in 1968, a gamma telescope was built that had a diameter of 10 meters and a mirror area of nearly 60 square meters. The focal distance of its component mirror is 7 meters. Such a large degree of illuminating power permits the recording of Cerenkov flashes by one photomultiplier with a diameter of 12.5 cm. But, in the American telescope the point image can not be smaller in size than 0.3 degree and, since the angular size of a Cerenkov flash all told is equal to 1 degree, then, of course, the point image should be at least one order smaller. It was precisely with the aim of obtaining a sufficiently good quality image of a flash that it was necessary to reduce the illuminating power of each individual telescope. As a result the point image in the CAO's gamma telescope has angular sizes of around 0.1 degree.

Each telescope consists of four circular mirrors, each with a diameter of 1.2 meters. The mirrors focus light falling onto them from a distant source into one point. They are produced from glass in the CAO's optical workshop and have a total thickness of 15 mm. Such mirrors are absolutely unsuitable for observing stars, but, on the other hand, thanks to their light weight, it is possible to install 24 mirrors on 1 assembly.

Within the focal plane there is a mosaic of 19 photomultipliers, onto which the Cerenkov flash radiation falls. At the same time, for more complete use of the light collected by the mirrors, light guides are used. The light guides are truncated cones made of plexiglass. Thanks to the total internal reflection from the side walls, all the light falling on the external broad base converges near the narrow base and falls onto the cathode of the photomultiplier. The electronic signals from the photomultipliers are amplified, converted to digital form and entered into a computer memory.

Several telescopes are used for recording the ultraviolet section of the Cerenkov radiation with $\lambda < 300$ nm. This region of the spectrum, obviously, had not been recorded previously. The amplitude of the signals from the ultraviolet section of the spectrum is also entered into the computer memory. As a result, after completion of the observations (or even during them), it is possible to conduct an analysis of the distribution of light in the flash and to determine its form and effective dimensions.

The swinging mechanisms of the assemblies have vertical and horizontal axes of rotation. In order to track celestial objects, the telescope is controlled by a computer. The use of a computer to control the telescope permits the possibility of scanning various objects. Without a computer, if scanning were done using only the rotation of the Earth, then it would be necessary to exclude from the list of objects being investigated, those which are close to a bright star. The use of a controlling computer permits the possibility of observing all interesting objects, without limitations. And finally, without using a computer, it would be impossible to remember and process that colossal volume of information, which the new gamma telescope is designed to gather.

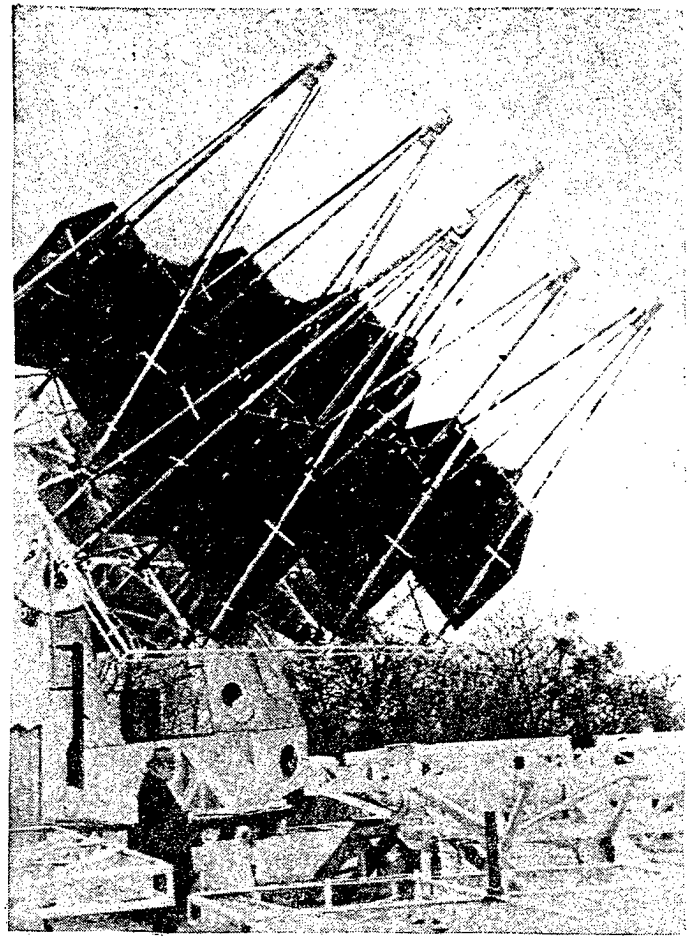

Fig. 1. A general view of one section of the Crimean Astrophysical Observatory's gamma telescope.

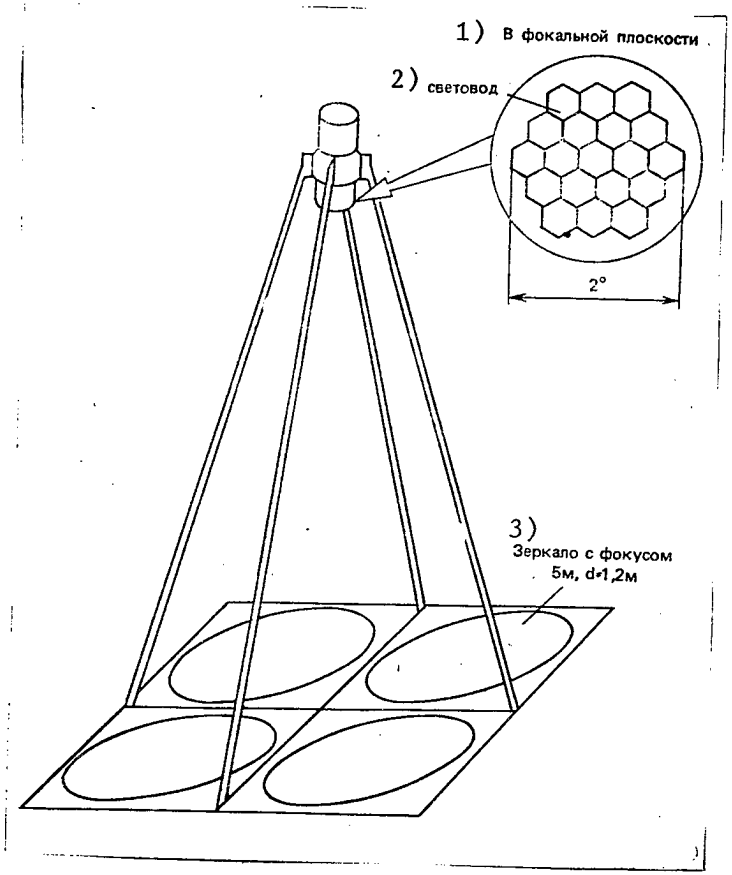

Fig. 2. Drawing of one element of the gamma telescope. 1) In the focal plane. 2) Light guide. 3) Mirror with a focus of 5 meters and a diameter of 1.2 meters.

In the autumn of 1984 the first observations were made on the first section of the gamma telescope. One of the significant results was the RECORDING OF THE ULTRAVIOLET SECTION OF THE SPECTRUM of Cerenkov flashes in the atmosphere. The fact is that because of the absorption of the shortwave section of the Cerenkov radiation in the atmosphere, its stream depends substantially on whether it has been caused by a gamma quantum or a proton. The proton shower penetrates deeper into the atmosphere and, therefore, its ultraviolet radiation is absorbed to a lesser degree. This permits the obtaining of additional information which aids in discerning the gamma quantums.

The results of the observations of the Cerenkov flashes in the optical range for the first time made it possible to determine experimentally not only the effective dimensions and form of the flashes, but also the fluctuations of their parameters.

Analysis of the data obtained makes it possible to hope that, with the start-up of the second section of the CAO's gamma telescope, it will be possible to successfully and efficiently conduct the search for and investigation of the gamma quantum streams from various astrophysical objects. There is no doubt that this research is opening up a new path for the study of the most interesting phenomena of nature, those which are associated with the generation of cosmic rays.

12752
CSO: 1866/43

COMET MODELING STUDIES AT PHYSICS INSTITUTE

Moscow PRAVDA in Russian 19 Feb 86 p 3

[Article by O. Korottsev, full member of the All-Union Astronomical-Geodetic Society of the USSR Academy of Sciences]

[Abstract] The article reports briefly on observations and studies in support of the International Program of Observations of Halley's Comet. This program is said to include a Soviet program of ground-based studies of Halley's Comet, which goes by the acronym SOPROG. Candidate of Physical-Mathematical Sciences K. Churyumov is identified as coordinator of visual observations under the SOPROG program.

One of the studies connected with the Soviet program reportedly involved experiments with modeling of the comet's nucleus, to verify the hypothesis that the nuclear consists of ice. These experiments were done by Ye. Kaymakov and V. Sharkov, science associates of the comet-modeling group of the USSR Academy of Sciences' Physical-Technical Institute imeni Ioffe in Leningrad. They used a vacuum chamber in which conditions close to those of outer space can be created. In the chamber they studied the behavior of artificial models of comet nuclei consisting of pure ice and ice polluted with dust particles, both with various chemical compositions. Some of the findings of the modeling experiments are noted in the article.

A photograph is given of Halley's Comet with its tail broken as a result of a change in the solar wind. The photograph reportedly was taken by S. Gerasimenko at the Tadzhik Academy of Sciences' Astrophysics Institute during the night of 10-11 January 1986.

FTD/SNAP
/8309
CSO: 1866/139

UDC 523.987

STRUCTURE, ACTIVATION OF SOLAR PROMINENCES DETERMINED FROM OBSERVATIONS IN RADIO, OPTICAL RANGES

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 63, No 1, Jan-Feb 86 (manuscript received 18 Jun 84) pp 162-165

[Article by G.P. Apushkinskiy, Leningrad State University]

[Abstract] The activation of prominences situated in activity complexes is analyzed. This matter is discussed using the example of radio observations of activation of a particular prominence, an event of 19-20 November 1980. The spectrum of brightness temperatures averaged for the prominence and the temperature structure obtained with adequate angular resolution are described in detail. These observations and data in the literature show that flares occurring in active solar regions often cause the activation of a nearby prominence. This effect travels along the photosphere in low-lying systems of magnetic arcs of a macroscale magnetic field and then, in such prominences, is transmitted upward. The fine structure of radio prominences is always optically thick, the radio emission emanating from the surface. There can be bright knots and "holes" without radio emission. A considerable similarity is observed in a comparison of the radio brightness distribution and the distribution in the UV. Figures 3; references 8: 6 Russian, 2 Western.

5303/8309
CSO: 1866/109

UDC 523.4:551.510.53

SEMIANNUAL OSCILLATIONS IN PLANETARY ATMOSPHERES

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 63, No 1, Jan-Feb 86 (manuscript received 14 Apr 83, after revision 25 Mar 85) pp 166-169

[Article by A.M. Krigel, Leningrad Hydrometeorological Institute]

[Abstract] There are clearly expressed oscillations with a semiannual period in the spectrum of oscillations of circulation in the earth's atmosphere, generated in the upper layers at the equator, taking in the entire stratosphere and affecting the dynamics of the lower layers. The factors responsible for this phenomenon are not clear. An effort was made to determine the existence of this phenomenon on other planets. Specifically, observations were made of circulation on other planets to ascertain whether their equatorial jet streams

are characterized by oscillations with a period equal to half the time of orbital revolution of such planets with a westerly drift maximum coinciding with the equinoxes. With respect to Venus, the great density of its atmosphere and therefore, greater friction, impede the development of a well-expressed semiannual cyclicity. The cases of Mars, Jupiter and Saturn were closely examined. In these cases the observational data indicate the existence of a semiannual cycle in the equatorial zones with a maximum velocity of rotation coinciding with the equinoxes. Figures 1; references 37: 5 Russian, 32 Western.

5303/8309
CSO: 1866/109

UDC 521.933:524.1

COSMIC RADIATIONS AND EARTH'S ROTATION

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 63,No 1, Jan-Feb 86 (manuscript received 29 May 84) pp 184-190

[Article by G.P. Pilnik, State Astronomical Institute imeni P.K. Shternberg]

[Abstract] Some aspects of the problem of using the earth's rotation as a detector of gravity waves are discussed. One approach is to clarify what periods exist in the earth's rotation and then to compare them with the periods of cosmic radiations. It is best to know all periods of nonuniformity in rotation rather than relying on the one or two most important. In such research much can be gained from study of radiation of the star Geminga in Gemeni, the period of this radiation and its possible relationship to oscillations of the solar surface and some corresponding nonuniformity in the earth's rotation. A table was prepared giving the periods, amplitudes and phases of the most reliably discriminated waves of intradiurnal nonuniformity of the earth's rotation. A wave with a period of $159^m.566$ is very close to the period of global oscillations of the solar surface $160^m.01$ and to the period of gamma radiation of Geminga--$159^m.96$. An analysis of mass astronomical time determinations revealed the presence of a great number of harmonics with periods of 24 hours or less, but some of these may be erroneous and require checking on the basis of observations with very long baseline interferometers. Figures 2; references 21: 14 Russian, 7 Western.

5303/8309
CSO: 1866/109

UDC 524.35

OBSERVATIONS OF GAMMA BURST OF 13 JUNE 1979

Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 11, No 12, Dec 85 (manuscript received 17 Jun 85) pp 906-910

[Article by S.V. Golenetskiy, Ye. P. Mazets, R.L. Aptekar, Yu. A. Guryan and V.N. Ilinskiy, Physical Technical Institute imeni A.F. Ioffe, USSR Academy of Sciences, Leningrad]

[Abstract] The short gamma burst of 13 June 1979 was registered with the "Konus" instrument on "Venera-11." The accumulation time when measuring the energy spectrum was 3.15 s and considerably exceeded the duration of the event. The low ratio between the signal and the background made it possible to measure the energy spectrum of the burst only from 30 to 230 keV. It was established that in this region the spectrum is soft and corresponds to a temperature kT$\sim$70 keV. This event was also observed in the "SNEG" experiments on "Venera-11" and "Venera-12," PVO and ISEE-3. A comparison of data from the different experiments revealed that the spectral evolution was strong and transpired very rapidly. The spectrum for this event was very similar to the spectra of other bursts observed earlier, including short bursts, containing two components: a relatively soft continuum with a temperature of about 100 keV and a hard component in the form of a broad line with a maximum of about 400 keV. The comparison of data from a series of experiments failed to reveal any fundamental differences distinguishing it from many other events. The only thing which is distinctive about this event is that it was observed from different space probes. Figures 2; references 4: 2 Russian, 2 Western.

5303/8309
CSO: 1866/88

UDC 521.1

COPLANAR LIBERATION POINTS IN PHOTOGRAVITATIONAL THREE-BODY PROBLEM

Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 11, No 12, Dec 85 (manuscript received 26 Jun 85) pp 930-933

[Article by A.L. Kunitsyn and A.T. Tureshbayev, Moscow Aviation Institute imeni Sergo Ordzhonikidze]

[Abstract] The nature of the dynamics of a particle of a gas-dust cloud in the field of two gravitating and emitting stars revolving relative to one another in circular orbits was studied by the authors earlier in PISMA V ASTRON. ZHURN., Vol 9, p 232, 1983; Vol 11, p 145, 1985. In that research it was established that there is a family of positions of relative equilibrium of particles in the plane of revolution of such stars--collinear and triangular libration points. That finding was consistent with a similar investigation by L.G. Lukyanov in ASTRON. ZHURN., Vol 61, p 564, 1984. This research was continued and it is demonstrated that there are positions of relative equilibrium (coplanar libration points) situated outside this plane (the existence of such

points was revealed by other authors earlier for different variants of the problem.) The point of departure (as in the earlier work) is the equation of motion of a particle in a rectangular barycentric coordinate system Oxyz rotating uniformly about the Oz axis, the objective being to find the positions of relative equilibrium of a particle in the plane Oxz. Proceeding along these lines, the coplanar libration points of a particle in the gas-dust cloud in the gravitational field of a binary are found with light pressure taken into account. The region of existence of a three-parameter family of coplanar points is found and their Lyapunov stability analyzed. Figures 2; references: 6 Russian.

5303/8309
CSO: 1866/94

UDC 523.9-4

INTERPRETATION OF OBSERVATIONS OF 160-MINUTE SOLAR OSCILLATION

Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 12, No 3, Mar 86 (manuscript received 25 Jul 85) pp 238-246

[Article by A.G. Kosovichev and A.B. Severnyy, Crimean Astrophysical Observatory, USSR Academy of Sciences, Nauchnyy village]

[Abstract] The existence of a global oscillation of the sun with a period of about 160 minutes has been clearly demonstrated. There is only one maximum of the amplitude of this oscillation during one solar rotation about its axis. At present there is no reliable theoretical explanation of the phenomenon. After reviewing the literature it was clear that it was necessary to use observational data to clarify whether the 160-minute oscillation is a nonradical mode of characteristic solar oscillations and to determine the corresponding degree of the spherical harmonic. A search was made for the possible type of oscillation, making use of observational data on its phases and amplitudes. The rotational splitting of nonradical g-modes was then analyzed. On this basis some new observation schemes were proposed which can yield additional information on the phenomenon. The analyzed amplitudes and phases indicate that this oscillation is probably a mode with a degree of the spherical harmonic $\ell = 3$, whereas the observed splitting of the frequency of the oscillation due to solar rotation gives the value $\ell = 1$. As new observational data are accumulated the problem must continue to be reviewed. References 34: 11 Russian, 23 Western.

5303/8309
CSO: 1866/94

UDC 523.164

MULTIFREQUENCY LUNAR POLARIZATION OBSERVATIONS WITH RATAN-600

Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 12, No 3, Mar 86 (manuscript received 10 Jul 85) pp 247-252

[Article by M.N. Naugolnaya and N.S. Sovoleva, Special Astrophysical Observatory, USSR Academy of Sciences, Leningrad Affiliate]

[Abstract] Lunar surface parameters can now be ascertained quite reliably due to improved observation methods and instruments. By comparing such data with samples which have been returned to the earth, valid conclusions can be drawn concerning the surface layer. However, it has become clear that in order to ascertain permittivity, surface layer density and surface inhomogeneities it is insufficient to make measurements at only one or two frequencies. For example,

polarization measurements at a single frequency are adequate only in an idealized case of a homogenous ideally smooth surface. Surface roughness exerts a strong influence on the observed degree of polarization and on permittivity ε. Since the distribution of the degree of polarization over the lunar disk in the case of a rough surface is different from that for a smooth surface, the influence of roughness on permittivity can be separated from other effects. The RATAN-600 radio telescope was used in more precise determination of properties of the lunar surface layer at six frequencies in the wavelength range 1.38-31.3 cm: 1.38, 2.08, 3.9, 8.2, 13, 31 cm. Observations were made simultaneously at all wavelengths. The Stokes parameters $Q = I_x - I_x + I_y$ were measured. It was found that permittivity ε increases with an increase in wavelength and that the effective scattering angle θ is not dependent on wavelength. A decrease in ε with the shortening of λ is attributable primarily to a change in surface layer density. The thickness of the layer with rapidly changing properties is 4-6 cm. The density at this depth is consistent with "Apollo-12" data within the range ± 10 percent.

5303/8309
CSO: 1866/94

UDC: 535.361.551.521

REVERSE PROBLEMS OF ATMOSPHERIC OPTICS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 285, No 5, Dec 85 [manuscript received 5 Feb 85) pp 1091-1096

[Article by T.A. Germogenova, Institute of Applied Mathematics imeni M.V. Keldysh, USSR Academy of Sciences, Moscow]

[Abstract] Determination of the characteristics of the atmosphere and of the underlying surface based on information gathered by satellites concerning reflected solar radiation usually involves separate analysis of the coefficient of reflection of the underlying surface and the optical parameters of the atmosphere, including a number of simplifying assumptions. The operator symbols developed in the theory of solvability of boundary-value problems for the transfer equation allows the observed quantities to be expressed directly by means of transforms of the desired characteristics, facilitating analysis of the general problem and of various approximations. This article studies a plane parallel atmosphere with a horizontally heterogeneous underlying reflecting surface.

6508/8309
CSO: 1866/66

UDC 523.987-337

MEASUREMENT OF MAGNETIC FIELDS IN SOLAR PROMINENCES

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 62, No 6, Nov-Dec 85 (manuscript received 20 Apr 84) pp 1147-1153

[Article by G.M. Nikolskiy, I.S. Kim, S. Kuchmi, A.I. Stepanov and G. Stellmacher, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, USSR Academy of Sciences; Paris Astrophysical Institute, French National Research Center]

[Abstract] Determination of the magnetic field vector in solar prominences from an analysis of the Hanley effect is not adequately precise for fields greater than 30-40 gauss; use of the Zeeman effect for study of active prominences is preferable. Circular polarization must be registered along the entire line profile. Then instrumental effects can be discriminated from the magnetic field signal and allowance can be made for dependence of the field signal on brightness variations, line half-width and radial velocities. The first measurements of the longitudinal field by this method in the $H\alpha$ line were made in 1975 by specialists of the Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation using a special magnetograph [described elsewhere in the literature]; after 1978 the work was done in collaboration with the Paris Astrophysical Institute. The opticomechanical part was constructed in the USSR and the electronic system in France. Spectral scanning is with a Fabry-Perot interferometer and modulation is by a lithium niobate crystal. Since 1979 systematic measurements have been made in the $H\alpha$, $H\beta$ and D_3 lines in the longitudinal field of prominences of different types. For prominences of the active latitudes ($< \pm 35°$) $B_{//} \approx B$. The angle between the long axis of the filament and the line of sight is close to the angle between the long axis of the filament and the magnetic field vector. Figures 5; references 31: 7 Russian, 24 Western.

5303/8309
CSO: 1866/87

UDC 523.62-72-77+523.985-77*2

RADIO EMISSION FROM SHOCK WAVE IN SOLAR WIND

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 62, No 6, Nov-Dec 85 (manuscript received 23 Apr 84) pp 1154-1159

[Article by V.G. Ledenev, Siberian Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Siberian Department, USSR Academy of Sciences]

[Abstract] A study was made of the possibility of generation of radio emission by gas-dynamic shock waves (the shock waves observed in the solar wind cannot always be identified as magnetohydrodynamic shock waves). A model is proposed whose principal features are possibly observable: presence of an abrupt jump of electron temperature, a clearly expressed maximum of the energy of ionosonic

turbulence and a radio emission maximum several hours before the arrival of the shock wave proper (density jump). Therefore, the region of increased electron temperature at the front of a shock wave propagating along the magnetic field at great distances from the sun can be limited by a sharp temperature jump. The width of this jump is determined by the ionosonic turbulence developing in counterflows of hot and cold electrons. Then the high-energy electrons escaping from the front of the thermal wave generate plasma waves which are then transformed into radio emission. The model may also be applicable for conditions of the solar corona, at distances from the solar surface on the order of the solar radius, for sufficiently strong gas-dynamic shock waves propagating along the magnetic field of the corona. Figures 3; references 26: 16 Russian, 10 Western.

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CSO: 1866/87

UDC 523.985

CONTINUUM AND Hα EMISSION OF FLARE OF 4 JULY 1974

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 62, No 6, Nov-Dec 85
(manuscript received 18 May 84) pp 1160-1167

[Article by A.N. Babin, N.P. Dyatel and M.A. Livshits, Crimean Astrophysical Observatory, USSR Academy of Sciences; Kharkov Astronomical Observatory; Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, USSR Academy of Sciences]

[Abstract] A 2B flare occurred near the center of the solar disk at about 1400 UT on 4 July 1974. The flare occurred in the trailing part of a group with a δ-configuration of the magnetic field. A brightness increase in Hα at 1352 UT coincided with a radio burst at 10 cm ending a little after 1400 UT. This was followed by the second part of the radio burst with a maximum at about 1415 UT. A detailed study was made of the events between 1352 and 1400 UT. The study was based on observations made at the Astronomical Observatory at Kharkov University and at the Crimean Astrophysical Observatory, supplemented by photoheliograms from a Hungarian observatory (Debrecen). The observations revealed that prior to the actual onset of the explosive stage of this flare the regions of continuum and Hα luminescence coincided; then the distance between them increased to several seconds of arc. The brightness of the white flare knot exceeded by 30 percent the brightness of the undisturbed photosphere. The entire phenomenon can be related to an extremely great energy release in a system of loops rising to an altitude of not more than 7,000 km. At the base of these loops the flux in white light exceeded the Hα emission in the same place by almost two orders of magnitude. Already during the hard phase of the flare the phenomenon affected an ever greater system of loops and the area of its bases, the region of emission in Hα, also increased. It was clear that a common energy source was responsible for both types of emission in this period. Figures 6; references 18: 8 Russian, 10 Western.

5303/8309
CSO: 1866/87

UDC 521.176

EXPANSION OF PERTURBING FUNCTION CAUSED BY INFLUENCE OF LUNAR AND SOLAR ATTRACTION ON MOTION OF ARTIFICIAL EARTH SATELLITE

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 62, No 6, Nov-Dec 85 (manuscript received 15 Apr 84) pp 1168-1174

[Article by N.V. Yemelyanov, State Astronomical Institute imeni P.K. Shternberg]

[Abstract] In an earlier article (TR. GOS. ASTRON. IN-TA, Vol 49, p 122, 1980) the author described a method for finding perturbations in the elements of an intermediate orbit of a satellite. The method was based on solution of the generalized problem of two fixed centers. This intermediate orbit took into account the influence of the second and third zonal harmonics in the expansion of geopotential (these are the principal perturbing factors for most artificial satellites). This research was extended by the author in ASTRON. ZHURN., Vol 3, p 590, 1985, where it was demonstrated that in order to obtain third-order secular and short-period perturbations relative to the earth's oblateness and second-order long-period perturbations in the expansion of the perturbing function it is necessary to take into account not only the main term, but also terms proportional to the earth's oblateness. Thereafter (ASTRON. ZHURN., Vol 5, p 1021, 1984) the author and L.P. Nasanova found a means for taking into account perturbations from noncentrality of the earth's gravity field for an asymmetric variant of an intermediate orbit. All this research has now been integrated and expanded. An expansion is found for the perturbing function caused by the influence of lunar and solar attraction on the motion of an artificial earth satellite for an asymmetric variant of an intermediate orbit taking into account the second and third zonal harmonics in the expansion of geopotential. The expansion was obtained with an accuracy to terms proportional to I_3 and I_3/I_2, where I_2 and I_3 are coefficients on the second and third zonal harmonics respectively.
References: 6 Russian.
5303/8309
CSO: 1866/87

UDC 521.352

IMPROVEMENT IN ORBITAL ELEMENTS OF ARTIFICIAL EARTH SATELLITES JOINTLY WITH MORE PRECISE DETERMINATION OF OBSERVATION TIMES

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 62, No 6, Nov-Dec 85 (manuscript received 5 Dec 83, after revision 5 May 85) pp 1193-1200

[Article by R.A. Zeynalov, Institute of Space Research for Study of Natural Resources, Space Reserach Scientific-Production Association, Azerbaijan Academy of Sciences; Theoretical Astronomy Institute, USSR Academy of Sciences]

[Abstract] In an earlier study (ANALIZ DVIZHENIYA DEBESNYKH TEL I IKH NABLYUDENIY, Riga, Latv. GU, p 88, 1982) the author studied the possibility of improving the orbital elements of an artificial earth satellite on the basis of optical observations with inexact moments. The results obtained in the model example indicated that the condition equations free of time errors make it possible to obtain the orbital elements of artificial earth satellites with an

accuracy necessary for practical purposes. A method has now been proposed for improving orbital elements with simultaneous correction of the inexact moments of satellite observations. The problem is solved by the successive approximations method. In each approximation the orbital elements are refined first and then the observation times are made more precise. Model computations were made which revealed that the rms errors in orbital parameters and times when determining an orbit from optical observations of satellites with inexact moments in time are quite small. The systems of normal equations used are entirely satisfactory and the correlations between elements are few in number and not too strong. The proposed method was highly effective. A numerical example is given to illustrate application of the method. References: 7 Russian.

5303/8309
CSO: 1866/87

UDC 520.338

HYPERSENSITIZATION OF ASTRONOMICAL EMULSIONS USED AT BYURAKAN ASTROPHYSICAL OBSERVATORY (KODAK IIIaJ)

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 62, No 6, Nov-Dec 85 (manuscript received 9 Nov 82; after revision 10 Sep 83) pp 1211-1217

[Article by Dzh. A. Stepanyan, Byurakan Astrophysical Observatory, Armenian Academy of Sciences]

[Abstract] Kodak IIIaJ emulsion has excellent properties for study of faint galaxies. At the Byurakan Astrophysical Observatory a need was felt for further sensitization of this emulsion. The literature contained too little information on sensitization procedures and on methods for storing processed emulsions. It is clear that the hypersensitization regime must be dictated by the particular observational program. Heating in the air gives poorer results than in nitrogen. Hypersensitized plates are very poorly preserved in air. In a sealed chamber with nitrogen hypersensitized plates will keep for several weeks. Procedures have been proposed whereby such plates can be kept for several months. The appearance of large-scale inhomogeneities is highly dependent on the age of the emulsions. Large inhomogeneities appear systematically in emulsions over 2 years old. Inhomogeneities are rare on fresh emulsions. Soviet-produced driers can be used for hypersensitizaton purposes but for more uniform and effective results there is a need for fabricating special driers. Figures 2; references 9: 1 Russian, 8 Western.

5303/8309
CSO: 1866/87

UDC 522.59

IMPROVED HIGHLY PRECISE INSTRUMENT FOR ASTROMETRIC OBSERVATIONS UNDER LUNAR CONDITIONS

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 62, No 6, Nov-Dec 85 (manuscript received 20 Apr 84) pp 1218-1226

[Article by A.A. Gurshteyn, Institute of History of Natural Science and Technology, USSR Academy of Sciences; Space Research Institute, USSR Academy of Sciences]

[Abstract] The new automatic VPA-2 apparagus has been developed for highly precise astrometric observations directly from the lunar surface using the equal-altitude method with photoelectric registry of the transit times of a series of stars. It can be used in solving fundamental problems in lunar geodesy and geophysics such as studying motion of the poles on the lunar surface and in establishing initial points for developing a fundamental control network. This can be done if instantaneous selenographic coordinates can be determined with an accuracy to $\pm$10" or better. The VPA-2 is seen as an improved variant of the VPA-1, developed by A.A. Gurshteyn and A.A. Konopikhin in 1971. The total mass of the astroblock is less than 7 kg; it measures 250 x 900 x 120 mm; objective diameter is 50 mm; objective focal length is 630 mm; field of view diameter is $\sim$2°; maximum registered star magnitude is up to 7^m; accuracy in registry of averaged times of star transits is up to 1^s. There has been an increase in the accuracy of observations by an order of magnitude in comparison with the VPA-1, the mass of the astroblock has been reduced by 30 percent and the useful life of the apparatus has been increased by a factor of 2-3. Figures 4; references: 7 Russian.

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CSO: 1866/87

UDC 523.68

LAUNCHING OF GALACTIC PROBE USING MULTIPLE PERTURBATION MANEUVER

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 19, No 4, Oct-Dec 85 (manuscript received 11 Dec 84) pp 354-358

[Article by V.G. Surdin, State Astronomical Institute imeni P.K. Shternberg]

[Abstract] The author discusses the possibility of increasing the flight velocity of a probe by means of a series of perturbation maneuvers in the neighborhood of stars closest to the launching point. Such a perturbation maneuver has been repeatedly used in cosmonautics, such as in the "Pioneer" and "Voyager." The proposed method has much in common with the Fermi mechanism of acceleration of charged cosmic particles during their interaction with randomly moving magnetized clouds of interstellar gas. If white dwards or neutron stars are used for this purpose in principle it is possible to accelerate probes to thousands and tens of thousands of kilometers per second respectively. The characteristic acceleration time is slightly dependent on what star

population is selected as an accelerator. In the neighborhood of the sun this time is $\sim 10^5$ years, at the central part of a globular cluster $\sim 10^4$ years and at the nucleus of the Galaxy $\sim$100 years. The use of the components of close binary systems for a perturbation maneuver can reduce the acceleration time considerably because the orbital motion of these stars occurs at velocities 100-200 km/s and successive approach to both components of the binary system can give a velocity increment of 300-400 km/s. In globular clusters there are better conditions for both interstellar communication and interstellar travels. Tables 2; references 10: 6 Russian, 4 Western.
[47-5303]

UDC 521.1

STABILITY OF POSITIONS OF RELATIVE EQUILIBRIUM OF SPACE STATION AT TRIANGULAR LIBRATION POINTS IN THREE-BODY PHOTOGRAVITATIONAL PROBLEM

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 5, Sep-Oct 85 (manuscript received 5 Dec 83) pp 676-683

[Article by A.A. Perezhogin]

[Abstract] A generalized variant of the photogravitational restricted circular problem of three bodies (S, J, P) is given, but with the material point P replaced by a passively gravitating body by which a space station is modeled. It is further assumed that the "sail factor" A/m ("section-mass" ratio) of this body is not dependent on its orientation. (The latter can be ensured by supplying the station with an opaque spherical envelope of variable radius.) On the basis of the condition of stationarity of modified station energy it is possible to find two pairs of dynamically equivalent positions of relative equilibrium of its body when the station center of mass is situated at one of the stable triangular libration points of the photogravitational circular problem of three bodies. The adequate conditions for the resulting equilibrium solutions are found. It is shown that the positions of relative equilibrium of the station body and the adequate conditions for their stability are essentially dependent on the station "sail ratio." These conditions essentially are equivalent to the relationship between the main central moments of inertia for ψ_0: A_2' A_1' A_3'. The latter circumstance makes it possible to dispense with the initial assumption of nondependence of the station "sail ratio" on its orientation. In computing the required "sail ratio" for hovering at a triangular libration point at the required geocentric distance, it is necessary to ensure equilibrium orientation. The station body must be oriented in such a way that the main central axis of inertia corresponding to the mean moment of inertia will be directed in the plane of the main bodies at the angle ψ_0 to the line of gravitating bodies. A series of other conditions must also be satisfied. Figures 3; references 18: 12 Russian, 6 Western.

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UDC 531.13:521.154

ANALYTICAL SYNTHESIS OF INVARIANT CONTROL OF DESCENT IN ATMOSPHERE WITHOUT MEASURING PERTURBATIONS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 5, Sep-Oct 85 (manuscript received 29 Oct 84) pp 684-690

[Article by V.V. Velichenko and V.A. Kozminykh]

[Abstract] In an earlier article (KOSMICH. ISSLED., Vol 20, No 3, p 357, 1982) the authors demonstrated that the theory of synthesis of invariant systems, described by V.V. Velichenko in AVTOMATIKA I TELEMEKHANIKA, No 4, p 22, 1972, makes it possible to solve the methodological problem of an ideally precise landing in a disturbed atmosphere. The law of descent control synthesized earlier by the authors uses information on current perturbations and contains a procedure for the numerical prediction of unperturbed trajectories. This same problem is now solved on the basis of the theory of invariant synthesis without the measurement of perturbations (a theory outlined by V.V. Velichenko in AVTOMATIKA I TELEMEKHANIKA, No 3, p 15, 1974). This makes it possible to formulate the control law in a final form not containing any prediction, in the form of an explicit function only of the current phase coordinates of the descent vehicle. The numerical modeling confirms the validity of the descent control algorithm using invariant synthesis without measurement of perturbations. For all the considered perturbed trajectories the final descent range virtually coincides with the descent range along the reference trajectory. The law of change of effective aerodynamic quality k(t) along the perturbed trajectories has a smooth character. The maximum k value increases with a decrease in the final altitude H, but in the considered altitude range does not exceed the technically admissible value. Figures 3; references: 5 Russian.

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UDC 629.783:523.31:521.182

STRUCTURE OF PERTURBATIONS OF ORBITAL MOTION OF NAVIGATIONAL ARTIFICIAL EARTH SATELLITES OF NAVSTAR TYPE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 5, Sep-Oct 85 (manuscript received 6 Feb 84) pp 713-718

[Article by T.V. Bordovitsyna, L. Ye. Bykova, V.A. Tamarov and N.A. Sharkovskiy]

[Abstract] The formulation of a variety of algorithms for predicting the motion of navigational satellites requires a full knowledge of the structure of perturbations of their orbital motion for prediction intervals from 1 to 90 days. A numerical model for this purpose was developed. Table 1 gives data on change in the maximum prediction error caused by inaccuracy in determining the principal gravitational coefficients for times up to 60 satellite revolutions. Table 2 gives data for evaluating the influence of error in computing lunar and solar coordinates on the accuracy of motion of satellites of the NAVSTAR type at the end of a 30-day interval. Table 3 gives data on the influence of all geopotential harmonics to $V_{12.12}$ for such satellites in a 30-day interval;

perturbation values are given in resonant and nonresonant cases. Table 4 is a corresponding table for the end of a 90-day period. Table 5 gives data on the influence of lunar-solar perturbations for 30- and 90-day intervals. Other perturbations which must be taken into account include tidal deformations in the earth's body, light pressure and relativistic effects, the most important of which is light pressure. In the case of light pressure an important parameter is S/M, the ratio of the satellite presentation area surface to its mass M; table 6 gives data on the increase in perturbations from light pressure with an increase in the prediction interval for several S/M values. Table 7 gives data on the influence of tidal deformations and Table 8 on the influence of relativistic perturbations. Figures 4; references 8: 6 Russian, 2 Western.

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UDC 550.388.22.292.80

SCATTERING OF RADIATION BELT PROTONS IN WHISTLER MODE OF VLF EMISSION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23,No 5, Sep-Oct 85
(manuscript received 10 Apr 84) pp 729-735

[Article by Yu. V. Gotselyuk, S.N. Kuznetsov, V.A. Kuznetsova, B. Popelyavska, I. Kimak and K. Kudela]

[Abstract] During geomagnetic disturbances the "Intercosmos-5" artificial satellite registered two zones of proton leakage, including fluxes of quasi-trapped protons at $L \sim 3$-3.5. The presented data indicate that this leakage should be attributed to the mechanism of scattering of protons in the whistler mode of low-frequency electromagnetic radiation (VLF emission). This mechanism was analyzed for both quiet and magnetically disturbed periods. The energies of protons interacting with the whistler mode of VLF emission as a function of L were determined. The efficiency of this scattering is compared with scattering due to other mechanisms. The following explanation is proposed. During development of the main phase of a magnetic storm the plasmapause moves to lesser L and the injection of electrons with $E_e \lesssim 100$ keV occurs in outer regions beyond the plasmapause. During the magnetic storm recovery phase the plasmapause moves in the direction of larger L and at $L \approx 3.2$ E_{cr} decreases to $\sim$10 keV, resulting in cyclotron instability of electrons and the appearance of electromagnetic radiation of the whistler mode on which protons are scattered. The presented materials indicate that such interaction plays a significant role in the dynamics of radiation belt protons in the plasmapause region. Figures 4; references 15: 7 Russian, 8 Western.

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CSO: 1866/28

UDC 537.591

CHARACTERISTICS OF INTERPLANETARY MEDIUM AND SOLAR ACTIVITY DURING ORDINARY AND DEGENERATE FORBUSH DECREASES IN COSMIC RAYS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 5, Sep-Oct 85 (manuscript received 14 Feb 84) pp 736-742

[Article by N.N. Kontar, G.P. Lyubimov, N.V. Pereslegina, V.I. Tulupov and Ye. A. Chuchkov]

[Abstract] A Forbush decrease of the quasistationary type was observed during the period 5-8 April 1968. Recovery after the Forbush decrease continued for 12 days, but at that time a new disturbance of the intermagnetic field occurred and a new high-velocity solar wind stream began. A Forbush decrease in cosmic ray intensity should have been observed but did not occur. Accordingly, an attempt was made to explain the different modulating effect of the two high-velocity solar wind streams observed in April 1968. A quite good approximation of ordinary and "degenerate" Forbush decreases was found by using the parameters of the solar wind and the interplanetary magnetic field with allowance for the slow variation in cosmic ray intensity which arises due to change in global solar activity. The use of active region parameters gives an explanation for the Forbush decrease in both phases by invoking the concepts of convection and transparency at any point in the medium. An indirect confirmation of the hypothesis of active regions as the sources of high-velocity quasistationary solar wind streams was obtained. It was found that quiet sectors of the solar atmosphere correspond to a low-velocity solar wind. A quiet solar wind carries a photospheric or chromospheric background magnetic field. Streams of different polarity are separated by a double narrow layer of dense plasma with the layers being separated by the magnetic field neutral line. Figures 3; references 11: 6 Russian, 5 Western.

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CSO: 1866/28

UDC 551.521.6

OBSERVATION OF EVENT OF 16 MAY 1981 IN OPTICAL AND KILOMETER RADIO RANGES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 5, Sep-Oct 85 (manuscript received 29 Apr 84) pp 743-747

[Article by V.P. Grigoryeva and V.S. Prokudina]

[Abstract] A powerful chromospheric flare developed on the sun on 16 May 1981 and was observed by both optical and radio methods. A series of surface observations with an interference-polarization Hα-filter made it possible to trace the evolution of active phenomena at the chromospheric level over the course of several hours. At the same time observations of kilometer radio emission were made at frequencies from 2160 to 114 kHz with a low-frequency 10-channel radiometer carried aboard the "Prognoz-8" artificial earth satellite. Data from optical and radio observations were compared in different stages of flare development. The article gives the results of comparison of active phenomena developing at the chromospheric level and phenomena transpiring at

coronal altitudes. There were several main stages in development of this flare: preliminary stage, stage of vigorous flare development with formation of two-ribbon emission, stage of formation of an arch structure and flare decay stage. During the explosive phase, at the time of formation of two-ribbon emission, there was a radio emission burst similar to a type-III burst with a rapid frequency drift. At great altitudes R = 8-20 $R_\odot$ the leakage of particles from the shock front occurred. In the post-maximum period of existence of arch structures no special phenomena were observed in the flare in the kilometer range other than small noise bursts. Figures 1; references 10: 2 Russian, 8 Western.

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CSO: 1866/28

UDC 581.521.6

LAG IN ESCAPE OF HIGH-ENERGY SOLAR PROTONS INTO INTERPLANETARY SPACE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 5, Sep-Oct 85 (manuscript received 16 May 84) pp 748-753

[Article by N.N. Volodichev, B.M. Kuzhevskiy, O. Yu. Nechayev and I.A. Savenko (deceased)]

[Abstract] The lag in escape of solar high-energy protons toward the earth is examined in detail. The lag in arrival at the earth is due to retention in the solar corona; there is no delay during their propagation in interplanetary space. The delay in receipt of high-energy protons was first detected by the network of surface neutron monitors. This phenomenon was first observed on an artificial earth satellite by the "Prognoz-2" during the solar event of 7 August 1972. Measurements by artificial satellites and neutron monitors give identical values of the mean lag time (10-20 min). This lag is not dependent on flare longitude in the sun's western hemisphere. Two reasons can be suggested for the particle lag: 1) already accelerated particles are held back for some time in the solar atmosphere, 2) the lag may correspond to the time interval between acceleration from low to high energies. It is possible that such particles are already accelerated to high energies in the solar corona or even in interplanetary space on moving shock waves. In such a case the time interval between the generation of electromagnetic radiation and the generation of high-energy particles may attain tens of minutes. Some of the particles may be held back in a trap and the lifetime of the trap determines the magnitude of the lag. The absence of a longitude dependence in the lag in particle escape, assuming that the lag is caused by the retention of accelerated particles in the flare region, means that the retention time is considerably greater than the time for propagation of particles from the place of generation to the lines of force along which they escape and move toward the earth. Figures 2; references: 15: 3 Russian, 12 Western.

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CSO: 1866/28

UDC 581.521

RELATIVE CONTENT OF HEAVY IONS IN INNER ZONE OF EARTH'S RADIATION BELTS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23,No 5, Sep-Oct 85
(manuscript received 12 Jan 84) pp 754-765

[Article by M.I. Panasyuk]

[Abstract] A detailed analysis was made of the relative content of H and He ions, especially in the inner radiation belt, and also such rare ions as O and Fe. The data used were registered by the "Molniya-2," "Cosmos-900," "Prognoz-5," "Explorer-45," ISEE-1 and OV1-19. It is shown that the dependence of relative content of H, He and O on energy, especially He/H and O/H, can be explained by a model providing for diffusion of ions into the depths of the radiation belt, with Coulomb losses taken into account. The existence of a spatial structure of dominant fluxes of He ions up to E $\approx$7 MeV at L $\approx$2.5 is demonstrated. The energy and radial dependence of O/H ratios in the equatorial radiation belts and Fe/O at low altitudes (350-500 km) does not contradict models of transport of ions of solar origin with injection spectra which are harder in the representation of total energies for heavy ions. The inner radiation belt in the neighborhood of the Brazilian Magnetic anomaly is the most probable place of localization of the O and Fe ions registered at low altitudes along satellite orbits. Figures 5; references 32: 13 Russian, 19 Western.

5303/8309
CSO: 1866/28

UDC 521.1

ONE METHOD FOR DETERMINING AERODYNAMIC PERTURBATIONS IN MOTION OF LOW-ORBIT ARTIFICIAL EARTH SATELLITES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 5, Sep-Oct 85
(manuscript received 5 Jul 84) pp 792-794

[Article by G. N. Generalova and Ye. L. Lukashevich]

[Abstract] It is essential to have a correct evaluation of aerodynamic perturbations in order to ensure accuracy in prediction of motion of artificial earth satellites in low orbits. The dynamic atmospheric model B 77 published by F. Barlier, et al. in ANN. GEOPHYS., Vol 34, Fasc. 1, p 9, 1978 was therefore applied in formulating a simple analytical method for making such an evaluation. The B 77 model was selected because it can be used in determining air density at a given altitude with such factors as the diurnal effect, solar radiation activity and the geomagnetic index taken into account. The assumption was made that during a time equal to the Draconian period of revolution in the N-th orbiting the satellite is acted upon by a perturbing acceleration directed opposite the velocity vector. This perturbing acceleration is dependent on air density, velocity and the ballistic coefficient averaged along the flight trajectory. The proposed algorithm for determining aerodynamic perturbations was used in predicting the line of the ascending branch of the "Salyut-7" across the equator. A three-day prediction, with refinement of the ballistic coefficient, was approximately 4 times more precise than similar computations made using known formulas for evaluating change in the semi-major axis in a static atmospheric model; no unwieldy formulas are involved. References 3: 1 Russian, 2 Western.

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UDC 531.13:521.154

DYNAMICS OF DESTRUCTION OF LARGE METEOROIDS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 5, Sep-Oct 85 (manuscript received 9 Apr 84) pp 797-799

[Article by V.A. Bronshten]

[Abstract] The progressive fragmentation of large meteoroids in the atmosphere was studied in detail by S.S. Grigoryan (DOKL. AN SSSR, Vol 231, No 1, p 57, 1976; KOSMICH. ISSLED., Vol 17, No 6, p 875, 1975). In the first of these studies, using a model of a gigantic body, he demonstrated that mass loss due to fragmentation is much greater than due to evaporation and fusion and therefore evaporation could be neglected. This conclusion is clearly incorrect, as is demonstrated in this critique. Formulas were derived for correctly describing the process and the importance of different parameters in these formulas is clarified. The values obtained were tabulated and a comparison with Grigoryan's data is given. Grigoryan's physical mechanism of meteoroid destruction remains valid even when evaporation is taken into account, but the process will transpire more rapidly. The combination of fragmentation, spreading out of particles and evaporation eventually leads to the explosive evaporation of the entire remaining meteoroid mass and this phenomenon is responsible for the observed final bolide flare. References: 8 Russian.

5303/8309
CSO: 1866/28

UDC 629. 197.2

ANALYSIS OF OPTICAL AUTONOMOUS NAVIGATION DURING SATELLITE MOTION IN ORBIT OF SLIGHT ECCENTRICITY

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 6, Nov-Dec 85 (manuscript received 7 May 84) pp 803-813

[Article by V.V. Ivashkin]

[Abstract] The characteristics of autonomous satellite navigation based on tracking of the horizon of a planet were studied. Such tracking could be accomplished using instruments detecting the horizon on the basis of planetary IR emission. However, it is preferable to use an autonomous navigation system based on optical sighting of stars near the planetary horizon. It is possible to register the times of star rising and setting or measure the altitude of stars above the horizon. Motion of a satellite in an orbit of slight eccentricity was examined. The analysis was made with a precise numerical algorithm and an approximate numerical and analytical method. Navigation accuracies corresponding to independent and correlated measurement errors were determined. It was found that an approximate method can be used in successfully determining navigational errors even in the case of a small number of measurements in orbit. Specifically, navigational accuracies can be ascertained in slightly elliptical orbits of artificial earth satellites at altitudes from 300 to 36,000 km. Figures 5; references 11: 10 Russian, 1 Western.

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UDC 629.197,528.563

GRADIENTOMETRIC NAVIGATION IN NEIGHBORHOOD OF COLLINEAR LIBRATION POINTS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23,No 6, Nov-Dec 85
(manuscript received 25 Jun 84) pp 814-819

[Article by A. Yu. Kogan]

[Abstract] The natural satellites closest to planets have small masses and small periods of revolution, leading to great instability of the satellite orbits around the natural satellites of planets. However, the closeness of the collinear libration points L_1 and L_2 to them affords the possibility of placing space vehicles at one of the libration points for study of the natural satellites. Although the holding of a space vehicle at a collinear libration point imposes rigorous requirements on navigation accuracy, the determination of the position of a space vehicle from independent measurements of tidal forces makes it possible to meet these requirements. Great emphasis was placed on choosing the orientation of the instrument ensuring maximum accuracy in navigational determinations. A navigational system was proposed with a gradientometer for measuring the mixed second derivatives of gravitational potential in coordinates. A linear algorithm for processing measurement data was proposed for the neighborhood of the libration points L_1 and L_2. A priori estimates of the accuracy in determining position were calculated. It was found that gradneitometric navigation would be most effective in the rapidly rotating systems Mars-Phobos and Jupiter-Amaltheus. Figures 3; references: 2 Russian. [as printed]

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METHODS FOR INCREASING ACCURACY IN NAVIGATIONAL DETERMINATIONS OF NEAR-SURFACE OBJECTS USING SATELLITE NAVIGATIONAL SYSTEM

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 6, Nov-Dec 85
(manuscript received 6 Mar 84) pp 820-828

[Article by M.P. Nevelko, S.D. Silvestrov, V.A. Arkhangelskiy, A.V. Mikhaylov and V.V. Kulnev]

[Abstract] The basis for this research was established by V.I. Ogarkov, et al. in "Refinement of Parameters of Motion of Orbital Spacecraft Using Navigational Satellites," KOSMICH. ISSLED., Vol 20, No 1, p 41, 1982. The analysis and equations presented in the new study ensure the possibility of effective navigation of a "user" on the basis of measurements of the pseudoranges and pseudovelocities to a number of space vehicles for which there is no synchronization of onboard frequency generators or when this synchronization is encumbered with inadmissibly great errors. The outlined procedures ensure a quite high accuracy in determining the coordinates of the user. The use of special

Doppler measurements of the parameters of motion of space vehicles can be highly useful for determining the coordinates of the user. The coefficients for transformation of errors in measurements and ephemerides into errors in navigation for the user were determined and the systematic errors in measurements of the differences in pseudoranges to different pairs of space vehicles were determined more precisely. The conditions under which such problems can be solved were defined and expressions were derived for determining the minimum duration of an observation session. Figures 2; references: 4 Russian.

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UDC 629.782

APPLICATION OF DUALITY THEORY TO PROBLEMS IN EVALUATING ACCURACY OF SPACECRAFT ORBITAL PARAMETERS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 6, Nov-Dec 85 (manuscript received 27 Jan 85) pp 849-862

[Article by L. Yu. Belousov and Ye. A. Kuzmin]

[Abstract] In an earlier article (the basis for this research) entitled "Minimax Evaluation of Accuracy in Determining a Space Vehicle Orbit With Allowance for Nonsimulated Accelerations" (KOSMICH. ISSLED., Vol 2, No 5, p 713, 1964) a study was made of the problem of determining the orbit of a spacecraft influenced by undetermined perturbing forces stipulated by a symmetric family of limited functions. An effort was made to apply linear programming methods for solving extremal problems because of the simplicity and effectiveness of the corresponding algorithsm. However, there are cases when simplex method algorithms are inapplicable. A regularizing method applicable to such cases is proposed. It was demonstrated that the solutions obtained by the proposed method and with the initial formulation are equivalent. A correlation was established between the problem of optimum choice of the types of measurements and a pair of duality problems. Examples of such problems were examined and a numerical algorithm was written for their solution in the form of the successive approximations method. References: 6 Russian.

5303/8309
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UDC 621.317

CHARACTERISTICS OF LONGITUDINAL CURRENTS IN CUSP AS FUNCTION OF ORIENTATION OF INTERPLANETARY MAGNETIC FIELD ACCORDING TO DATA FROM 'INTERCOSMOS-BOLGARIYA-1300' ARTIFICIAL EARTH SATELLITE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 6, Nov-Dec 85
(manuscript received 1 Mar 84) pp 886-893

[Article by L.N. Zhuzgov, L.O. Tyurmina, V.A. Sharova, S.I. Shkolnikova, V.I. Lazarev and M.V. Teltsov]

[Abstract] The structure and intensity of longitudinal currents in the cusp were investigated as a function of orientation of the interplanetary field on the basis of data from the "Intercosmos-Bolgariya-1300" artificial satellite. The position of the daytime cusps was determined from the spectral characteristics of the measured fluxes of charged particles and the direction and intensify of the longitudinal currents were determined from magnetic measurements. Simultaneous measurements were made of the three components of the magnetic field and fluxes of charged particles with $0.4 \leqslant E \leqslant 15$ keV in the daytime sector of local geomagnetic time. The asymmetry of longitudinal currents in the northern and southern polar cusps was studied. Strong small-scale currents were discovered in the cusp which were accompanied by a sharp increase in the flux of charged particles. There is a clearly expressed dependence of the direction and intensity of transverse magnetic disturbances (and therefore, the longitudinal currents corresponding to them), on the sign and strength of B_y and B_z of the interplanetary magnetic field. With $|B_y| > |B_z|$ there is predominance of magnetic disturbance directed to the east or west, depending on orientation of B_y of the interplanetary field. With $B_y > 0$ ($B_y < 0$) the vector of magnetic disturbance is directed to the east (west). This can be interpreted as intersection of the longitudinal current flowing into the ionosphere (flowing from the ionosphere). The weaker magnetic disturbances observed in the polar and equatorial parts of the current system are evidently caused by weak currents of opposite direction. There is an appreciable difference in the intensity of longitudinal currents in the northern and southern cusps. Figures 5; references 9: 2 Russian, 7 Western.

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ENERGETICS AND IR EMISSION OF NO IN DISTURBED HEATED THERMOSPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 6, Nov-Dec 85 (manuscript received 11 May 84) pp 894-901

[Article by B.F. Gordiyets and M.N. Markov (deceased)]

[Abstract] A study was made of IR emission in the 5.3 μm band of NO in an energetically disturbed thermosphere within the framework of a model self-consistent with respect to both chemical and ion composition as well as energy gains and losses. The model emphasizes an analysis of heating by an electrical field perpendicular to the geomagnetic lines of force. The field causes heating of ions and then, due to energy transfer in ion-atomic collisions, heating of neutral gas. Also considered in the model are such sources of heating of the thermosphere as solar UV radiation, fluxes of fast electrons leaking from the magnetosphere and chemical reactions. The process of molecular thermal conductivity, IR emission in the line 63 μm of atomic oxygen and IR emission in the vibrational-rotational bands of CO_2, NO^+, $N^{14}N^{15}$, CO, O_3 and OH molecules were used in describing energy losses from the thermosphere. It was found that energy losses from the thermosphere are almost entirely determined by the IR emission of NO in the 5.3 μm band. NO IR emission stabilizes temperature of the thermosphere. A change in the inflow of energy in the range $1\text{-}10^3$ erg.cm^{-2}.s^{-1} results in a temperature increase only from $\sim$1000 to $\sim$ 2500 K. Figures 5; references 24: 9 Russian, 15 Western.

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CHARACTERISTICS OF FLUXES OF HIGH-ENERGY ELECTRONS IN TRANSITION REGION DURING INCREASED GEOPHYSICAL ACTIVITY

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 6, Nov-Dec 85 (manuscript received 5 Jul 84) pp 902-908

[Article by Yu. V. Mineyev and Ye. S. Spirkova]

[Abstract] Electron fluxes were measured by the "Prognoz-4" during the period January-March 1976. A differential spectrometer operating in the energy ranges 0.3-0.5, 0.5-0.8, 0.8-1.2, 1.2-2.0, 2.0-3.0 MeV was used; protons with energies $E_p > 0.5$ MeV were also registered. On 6 March 1976 the satellite emerged from the solar wind into the transition region on the daytime side, interesected the magnetopause at $\varphi Sm \sim 45°$ and penetrated into the magnetosphere to an altitude $\sim$1,700 km. The increased geophysical disturbance of 3 March was associated with the recovery phase of D_{st} variation developing with transition of the earth into the negative sector of the interplanetary magnetic field. A layer with an increased flux of particles (in comparison with the background) was registered at the intersection of the magnetopause and the

transition region; this layer was observed for a distance $\sim 8R_E$. Very strong bursts of these particles were also observed in the outer high-latitude magnetosphere. The thick layer of high-energy electrons is evidently attributable to the mechanism of frictional acceleration during flow of the solar wind around the magnetosphere. This is the result of wave-particle interaction in the process of intensive rejoining of the lines of force of the interplanetary and geomagnetic fields over the entire surface of the magnetopause. Figures 4; references 11: 3 Russian, 8 Western.

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UDC 551.510.535

ENERGY DISSIPATION OF POWERFUL MICROWAVE RADIATION IN IONOSPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 6, Nov-Dec 85 (manuscript received 5 Jul 84) pp 909-911

[Article by A.M. Vasyutkin, V.L. Krasovskiy and V.N. Orayevskiy]

[Abstract] Estimates of anomalous absorption of energy by strong microwaves in the ionosphere associated with the excitation of plasma oscillations as a result of decay processes were made. The principal mechanism of absorption of the energy of a microwave and the heating of plasma is usually Joule heating caused by the collision of electrons with heavy particles. The source of generation of plasma waves may be isometric instabilities of plasma in a field of powerful radiation. The "fastest" of these instabilities, whose increments under definite conditions exceed the frequency of collisions, are especially emphasized; estimates of these increments are made using well-known expressions for isotropic plasma. It was found that in the case of sufficiently great energy fluxes he intensity of anomalous dissipation can exceed Joule losses. The proposed model of development of plasma turbulence requires improvement. A more rigorous quantitative analysis would require inclusion of a description of the nonlinear dynamics of the spectra of excited waves, the effects of influence of the magnetic field, plasma inhomogeneity and real beam geometry. Self-consistent allowance for these mechanisms may result in some modification of concepts concerning heating of the ionosphere and processes such as self-focusing of a beam and stratification of ionospheric plasma. References 13: 9 Russian, 4 Western.

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UDC 581.521

SPATIAL DISTRIBUTIONS OF PROTONS AT HIGH AND LOW ALTITUDES IN RADIATION BELTS. COMPARISON OF THEORY AND EXPERIMENT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 6, Nov-Dec 85 (manuscript received 29 Nov 84) pp 912-920

[Article by M.I. Panasyuk, S. Ya. Reyzman and E.N. Sosnovets]

[Abstract] An analysis was made of the spatial structure of the proton radiation belt outside the equatorial plane for estimating the dependence of the radial diffusion coefficient on latitude and determining the contribution made by the pitch-angle scattering of protons to the formation of the spatial structure of the proton radiation belts. The study was based primarily on measurements of protons in the energy range 50-500 keV by the satellites "Molniya-1" and "Cosmos-900" at altitudes in the range 40,000 km-500 km. All the data considered were registered in periods of low magnetic activity when the spatial and temporal variation of protons was relatively small. It was found that radial diffusion with a diffusion coefficient not dependent on geomagnetic latitude is the principal mechanism responsible for spatial distributions of protons to geomagnetic latitudes $\Lambda \approx 40°$. Both experimental data and computations are consistent on the assumption of an effect of both magnetic and electric diffusion, although in the latter case a model of a spatially inhomogeneous electrical field of diffusion must be invoked. At $\Lambda \gtrsim 50°$, pitch-angle scattering makes the main contribution to formation of the spatial structure of protons at low altitudes. An estimate of the exponent for slope of the curve of radial distribution of cold electrons was made. Figures 4; references 22: 9 Russian, 13 Western.

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CHARGED PARTICLE FLUXES IN INNER MAGNETOSPHERE IN SOUTH ATLANTIC MAGNETIC ANOMALY AND EFFECTS OF STRONG PITCH-ANGLE AND RADIAL PLASMA DIFFUSION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 6, Nov-Dec 85 (manuscript received 25 Jun 84) pp 921-925

[Article by N.M. Shyutte and N.I. Izhovkina]

[Abstract] New data on charged particle fluxes in the South Atlantic Magnetic Anomaly region were collected by the "Cosmos-900" satellite in a quasicircular orbit at an altitude of 500 km, $L \lesssim 2$. During passage through the anomaly during both daytime and nighttime, ions and electrons with energies 100 eV-20 keV and pitch angles close to $\pi/2$ were registered. In all cases the energy distributions fluctuated, even under very calm geomagnetic conditions. It was clear that the parameters of these fluxes are closely related to geomagnetic field strength. There was a diurnal (day and night) asymmetry of parameters in this region. Analysis of the data suggested that these fluctuating spectra

were attributable to dropping-down of the magnetic mirror points of particles quasitrapped by the geomagnetic field into the ionosphere. This resulted in an intensification of the flux of leaking particles. At the same time, strengthening of the plasma flow into the cone of losses may account for the observed accentuation of wave disturbances, as well as intensification of pitch-angle distribution. Assuming the correctness of these hypotheses, estimates were made for the diffusion of electrons during interaction with whistlers. Figures 2; references 11: 2 Russian, 9 Western.

SOLAR AND GALACTIC COSMIC RAY FLUXES IN ARTIFICIAL EARTH SATELLITE ORBITS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 6, Nov-Dec 85
(manuscript received 25 Apr 84) pp 944-946

[Article by I.V. Getselev, V.A. Kuznetsova, V.I. Severinov and G.A. Timofeyev]

[Abstract] A comparison of particle fluxes in artificial satellite orbits and in interplanetary space is required for planning and interpreting the results of measurements of solar cosmic rays (SCR) and galactic cosmic rays (GCR). Solution of such problems is difficult due to complexity of computations and lack of the needed volume of initial data on magnetic disturbances, nonstationary electrical fields and state of the atmosphere. Solution is greatly simplified using the magnetic drift shell L; with availability of data on cosmic rays outside the magnetosphere it is possible to determine the energy spectra of particles at different drift shells. If the probability of presence of satellites at drift shells is known, the energy spectra of SCR and GCR particles can be determined. The function L(t), describing the dependence of the satellite L coordinate on time, is used as a point of departure. The range of change of L values is broken down into a number of intervals, each of which is assigned the mean value of the parameter L_k and the corresponding geomagnetic cutoff energy value E_k. The total time of presence of a satellite in the L_k intervals and the time of its flight in the regions of the magnetosphere reached by cosmic particles with the energy E_k are determined. Proceeding along these lines, for each orbit it is possible to introduce a characteristic defining the fraction of cosmic particles reaching a satellite and not dependent on its flight time. The procedures are illustrated for three different orbits. The method makes it possible to take geomagnetic disturbances into account when computing SCR and GCR fluxes in satellite orbits. Testing of the method for about 350 satellite orbits revealed excellent results. Figures 1; references 4: 2 Russian, 2 Western.

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DETERMINING SPATIAL SCALES IN MOVING PLASMA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23 No 6, Nov-Dec 85
(manuscript received 27 Jun 85) pp 947-949

[Article by O.L Vaysberg]

[Abstract] Many difficult problems can be solved by data registry on several spaced probes. Use can be made of the favorable spatial configurations of satellites and interplanetary probes launched under independent programs. However, there are very promising methods for determining linear scales, as in moving plasma, when using individual probes. For example, measurements of the three-dimensional distribution of high-energy ions made it possible to determine the distance from a satellite to the boundary of trapping of particles and to study the movement of this boundary. It has been the dissatisfaction of researchers with the ambiguity of the results of measurements with a single vehicle which led to the development of multiprobe systems. The "Interbol" and ISTP projects, for example, call for use of "tail" and "auroral" probes with subsatellites for investigating the magnetosphere and a system of space vehicles probing the tail, the equatorial and auroral zones and monitoring the solar wind. In reality, dozens of simultaneously operating probes may be required for studying dynamics of the geomagnetosphere; meanwhile, the spatial structure of a number of current structures in space plasma could be studied using a single probe. This is made possible using the Maxwell equation

$$\text{rot } B = \frac{4\pi}{c} j,$$

usually used in estimating current density in a spatial configuration which is known or assumed to be known. Making simultaneous magnetic field and current density measurements with a single probe it is possible to solve the inverse problem of determining the spatial scale of a phenomenon when using the Maxwell equation. The problem of computing rot B remains, but in the case of almost plane current sheets such as the magnetopause or a shock wave front, it is possible to determine their thickness from a single probe. Other possibilities of effective use of a single probe are also cited. References 22: 4 Russian, 18 Western.

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TASS REPORTS 'VEGA-1' ENCOUNTER WITH HALLEY'S COMET

Leningrad LENINGRADSKAYA PRAVDA in Russian 7 Mar 86 p 11

[TASS Report]

[Excerpt] The Soviet automatic station "Vega-1," whose flight is taking place within the framework of the multipurpose international project "Venera--kometa Galleya," has successfully carried out its program of research of Halley's Comet.

On 6 March 1986, the "Vega-1" station passed through the comet's gas-and-dust shell at a distance of about 9,000 kilometers from its nucleus and performed comprehensive scientific studies of this heavenly body for the first time.

With the aid of apparatus developed jointly by scientists and specialists of the USSR, Austria, Bulgaria, Hungary, the German Democratic Republic, Poland, France, the Federal Republic of Germany and Czechoslovakia, large-scale pictures of the comet's nucleus have been obtained for the first time, and measurements have been made of the temperature and other physical-chemical characteristics of the comet. The chemical composition of gas and dust component substances of the comet has been analyzed, and studies have been made of electromagnetic fields around the comet and of physical processes taking place in its shell.

During a period of communication on 4 March, the first television pictures of the comet were received and studies of the comet began from a distance of 14 million kilometers. A servo platform with television cameras installed on it and scientific instruments were aimed automatically at the comet's nucleus. Picture-taking and studies of Halley's Comet were continued on 5 March, from a distance of about 7 million kilometers.

A three-hour period of scientific measurements and picture-taking was carried out on 6 March, during the "Vega-1" station's passage near the comet's nucleus at a relative velocity of about 80 kilometers a second. More than 500 television pictures taken through various light filters were transmitted to Earth during the periods of communications, which made it possible to obtain color images of the comet and its nucleus.

According to telemetry data, the onboard systems of the automatic interplanetary station "Vega-1" have retained their operational fitness and are functioning normally following the station's flight through the comet's gas-and-dust shell. Plans call for conducting final periods of research of the comet on 7 and 8 March.

Information which allows the comet's trajectory of movement to be calculated more precisely has been obtained as a result of television observations made from the automatic station "Vega-1." These data will be transmitted to the European Space Agency after processing, so that they can be used for guiding the spacecraft "Giotto" which is approaching the comet.

On 9 March, the "Vega-2" station will pass the comet at the minimum distance from its nucleus.

The scientific program of the project "Venera-kometa Galleya" is being coordinated with research of Halley's Comet which organizations of the European Space Agency, the United States and Japan are conducting.

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INTERPLANETARY SCIENCES

COMMENTARY ON RESULTS FROM 'VEGA-1'

Moscow KOMSOMOLSKAYA PRAVDA in Russian 7 May 86 p 12

[Article by S. Leskov]

[Abstract] The article reports on activities and records comments of scientists at the USSR Academy of Sciences' Institute of Space Research during observations of Halley's Comet with the automatic station "Vega-1" on 6 March. Professor Albert Abubakirovich Galeyev, a Lenin Prize laureate, is quoted in regard to studies of interactions of the solar wind and the comet's atmosphere which were being conducted. Galeyev is credited with a major role in the preparation of the "Vega" project.

Some findings from "Vega-1" data are mentioned. The comet's magnetic field was found to have an intensity as high as 75 nanoteslas. Instruments recorded impacts of up to 3,000 dust particles per square decimeter each second while the station was passing the comet at the minimum distance of 9,000 kilometers from its nucleus. A large quantity of water vapor was detected, as well as the presence of all molecules with a weight of less than 28. The comet's nucleus was found to have a diameter of 3-4 kilometers.

The data from the station also revealed a number of characteristics of the comet which are said to conflict with scientists' earlier notions. Flows of dust inside the comet's dust paraboloid proved to be at least 10 times smaller than expected, for example. Also discovered inside the dust cloud were small particles traveling at higher speeds than larger ones. Particles smaller than what scientists had thought could exist were detected. Their weight is less than 10 to power -16 gram. A plasma-oscillation maximum in the region of 1 kilohertz was recorded, which is said to indicate an unusually high density of protons in the shock wave accompanying solar wind-atmosphere interaction. It is noted that these findings are preliminary ones which require further checking.

Mention is made of a minicomputer called "Delta" which is used for high-speed processing of data streams at the Space Research Institute. It is said to have the largest capacity for this purpose of any system in the country. It was developed at the Ukrainian Academy of Sciences' Institute of Cybernetics. Brothers Vladimir and Mikhail Dianov are identified as the developers of the "Delta."

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COMMENTARY ON 'VEGA' STATIONS' TELEVISION, SPECTROMETRY EQUIPMENT

Tallinn SOVETSKAYA ESTONIYA in Russian 8 Mar 86 p 2

[Article by Yu. Zaytsev (at the USSR Academy of Sciences' Institute of Space Research)]

[Abstract] The article reports on the progress of the flight of the automatic interplanetary stations "Vega-1" and "Vega-2" towards Halley's Comet. Information is provided on features of television, spectroscopic, mass-analysis and other equipment which these stations carried for research of the comet, purposes of these studies, and procedures which were followed in aiming the stations' instruments at the comet.

The stations' television systems are said to be based on picture receivers developed by specialists of the USSR, Hungary and France. These receivers' Soviet-produced matrices are made up of silicon photocells which convert video information into electric signals convenient for transmission to Earth. Each matrix is 10 x 10 millimeters square and contains about 300,000 cells, each of which is 24 micromicrons long and 18 micromicrons wide. Each television system consists of two cameras, a long-focus and a short-focus one, and a microprocessor which controls the operation of these cameras. Details approximately 100 meters in size can be distinguished from a distance of 10,000 kilometers with the aid of the long-focus camera, it is claimed. The short-focus camera, which has a wider field of view, is used to find the comet's nucleus and keep it within the other camera's field of view by transmitting signals to the station's rotating instrument platform.

In addition to the television system, this platform's optical instrument-complex reportedly includes instruments for detailed spectroscopic studies of the chemical composition of various regions of the comet's atmosphere (coma) and tail. Among these instruments are a three-channel spectrometer which was developed and built jointly by scientific institutions of Bulgaria, the USSR and France, and an infrared spectrometer which was developed and built in France and tested in the USSR by French and Soviet specialists, who were jointly to interpret data obtained with the spectrometer. One of the most important purposes of the spectroscopic studies was to search for primary molecules whose presence in comets has not yet been determined by ground spectroscopic measurements, it is explained.

A drawing of the "Vega" flyby module which transmits data to Earth is given.

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'VEGA-1' CONTINUES DATA, 'VEGA-2' APPROACHING COMET

Moscow MOSKOVSKAYA PRAVDA in Russian 8 Mar 86 p 2

[Article by N. Zheleznov, correspondent]

[Excerpt] The station "Vega-1" passed almost unharmed through the dust front surrounding the head of Halley's Comet. Following the hot encounter with this celestial wanderer, the station is continuing long-distance picture-taking and spectrometry of the comet and its surroundings. Meanwhile, headed toward the comet is the station "Vega-2," which has only 2 days, or 14 million kilometers, of its trip remaining until its encounter. Work was thus done today for the first time with the two interplanetary laboratories simultaneously at the Institute of Space Research, during the first half of the day.

"This unique opportunity to observe the comet from two sides at the same time has added not only to the work but also to the hopes of the large international group of specialists who have gathered in Moscow," said academician R. Sagdeyev, scientific director of this space-operations staff. "Not only discoveries themselves but their repeated confirmation are important in science. And we expect the 'Vega-2' station not only to repeat results that were obtained during the initial encounter with the comet but to add depth to them, on Sunday morning. Another important fact is that the first flyby enabled specialists to select even more informative operating modes for upcoming picture-taking. Today, for example, about 100 television frames were received from 'Vega-2'--almost twice as many as were taken from the same distance by 'Vega-1'."

Telemetry specialists confirmed today that practically all systems of the first station, including the lenses of its television system, have retained their operational fitness.

More precise calculations were made today of the distance at which the first station's meeting with the comet took place on 6 March. The two heavenly bodies--the artificial and the natural one--came within 8,900 kilometers of each other. The boundaries of the comet's solid matter and of its nucleus cannot be seen distinctly in pictures as yet, to be sure. The size of the nucleus appears to be as large as 4-5 kilometers, according to preliminary data. But the several hundred pictures that were taken in four days must undergo complex stages of processing and interpretation, in the first place. In the second place, "Vega-2" is expected to approach closer, to a distance of 7,000-7,500 kilometers from the comet, according to calculations made by specialists of the Control Center.

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TASS REPORTS 'VEGA-2' HALLEY ENCOUNTER

Moscow IZVESTIYA in Russian 10 Mar 86 p 1

[TASS Report]

[Excerpt] The large-scale, multipurpose program for the study of Halley's Comet with the aid of the Soviet interplanetary stations "Vega-1" and "Vega-2" has been carried out in its entirety. This program was drafted by scientists and specialists of countries that are taking part in the international project "Venera--kometa Galleya."

On 9 March 1986, at 1020 hours Moscow time, the "Vega-2" station passed Halley's Comet at the minimum distance of 8,200 kilometers from its nucleus. Television pictures were taken and physical-chemical characteristics of the nucleus were studied in the process, and studies were made of inner regions of the comet's gas-and-dust shell. A large amount of additional information was obtained on the dynamic properties, structure and composition of this heavenly body.

The "Vega-2" station's television system made its first studies of the comet on 7 March, when its distance from the comet was 14 million kilometers. The main period of scientific research took place on 9 March.

About 700 images of the comet, taken in different zones of the optical spectrum, were obtained with the aid of the "Vega-2" station's television apparatus. Valuable data on physical-chemical properties of the comet's nucleus was transmitted to Earth, as well as data on processes occurring in the gas-and-dust shell surrounding the comet.

The USSR Academy of Sciences' Institute of Space Research and other Soviet centers are processing incoming information in collaboration with organizations of Austria, Bulgaria, Hungary, the German Democratic Republic, Poland, the United States, France, the Federal Republic of Germany and Czechoslovakia that are taking part in work in line with the international project "Venera--kometa Galleya."

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INITIAL PROCESSING OF 'VEGA' DATA

Moscow PRAVDA in Russian 10 Mar 86 p 3

[Article by A. Pokrovskiy, correspondent at the USSR Academy of Sciences' Institute of Space Research]

[Excerpt] Scientists need an understanding of the nature, origin and evolution of comets. What, then, are they seeing during the periods of television communication which have now been conducted regularly for 6 days at the Information Display Center of the USSR Academy of Sciences' Institute of Space Research (IKI)?

"'Quick-analysis information' makes it possible to single out the main features of objects under observation," explained Doctor of Physical-Mathematical Sciences L. Mukhin, a science associate of IKI. "Well, it appears to me that the comet's nucleus, for example, is divided into two parts, so to speak. The fluctuations in the intensity of the magnetic field in the comet's atmosphere were also surprising. We shall ask that the attention of the institute's computer center be focused primarily on just such features. All scientific information received from the 'Vega' spacecraft will be processed extensively at this center."

"We prepared for such questions long in advance, even before the 'Vega' spacecraft were launched," said Candidate of Technical Sciences V. Krasikov, head of the laboratory for digital processing of images, continuing the conversation. A special computer program with an overall content of 150 kilobytes had been prepared by then. It calls, for example, for outlining sections of images which are of particular interest to specialists, constructing cross-sections, brightness differentiation, geometric transformations, and many other operations."

Data received from 14 instruments operating on each "Vega" travel a distance of 170 million kilometers through space.

"Let us at least schematically trace the path which video information, for example, travels from a 'Vega' to our video terminals," suggested V. Krasikov. Electromagnetic signals from the spacecraft reach the dish of a receiving antenna of the Deep Space Communications Center. A single stream of this data subsequently reaches our institute via cable communications. Special apparatus at the institute breaks down this stream into separate sections which are legible to a computer. On the basis of certain program characteristics,

computers then begin to separate readings of individual instruments from these sections and convert them into a form that is accessible for study--into images, in our case. The computers are programmed to remove extraneous 'noise' from signals and to take into account supplementary information, such as time and angle of picture-taking. This 'purified' information is transferred to magnetic tape and can then provide a basis for study in depth."

"Does this mean, then, that these magnetic tapes contain an 'image' of Halley's Comet, recorded in detail?"

"Yes, and not only they. The signals are magnetically recorded also at the Deep Space Communications Center. When we receive them from Yevpatoriya, it will be possible to check on whether any technical errors occurred during transmission. The likelihood of this is extremely small, but even it must be taken into account. After all, we not only have to record incoming information objectively but also perform very delicate operations, such as constructing a three-dimensional image of the comet's nucleus and the adjacent region of its coma, on the basis of pictures received."

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CSO: 1866/139

TRACKING NETWORK FOR 'VEGA' MISSION

Moscow PRAVDA in Russian 14 Mar 86 p 1

[Text] In line with the designated program, the Soviet automatic station "Vega-2" continued its studies of Halley's Comet on 10 and 11 March, after flying close by the nucleus of this heavenly body. During periods of communications, television pictures of the comet were taken from distances of 7 and 14 million kilometers, and scientific information on plasma processes and electromagnetic phenomena in interplanetary space was transmitted to Earth.

On 11 March, work was completed in line with the international project "Lotsman" (pilot), in which organizations of the USSR, the European Space Agency and the United States have been taking part. Within the framework of broad international cooperation, the locations of the stations "Vega-1" and "Vega-2" have been fixed with the aid of radio telescopes located in various parts of the Earth, and precise calculations of the comet's trajectory of movement have been made routinely in accordance with television images received from the stations. Joint use of data from space and ground measurements makes it possible to heighten by 10 times precision in determining the position of Halley's Comet and to track the European spacecraft "Giotto," which is approaching the comet, with a mean error of 80 kilometers at a distance of about 500 kilometers from the comet's nucleus.

Preliminary analysis of television images which were received on 6 and 9 March, during the flybys of the "Vega-1" and "Vega-2" stations at their minimum distances from the nucleus of Halley's Comet, has indicated that the nucleus is an irregularly shaped formation with very low reflectivity and a maximum size on the order of 11 kilometers.

According to telemetry data, a number of auxiliary systems and scientific instruments of the "Vega" stations and sustained slight damage from high-speed particles of comet matter following their passage through the comet's gas-and-dust shell, as was expected. However, protective equipment on the stations has made it possible to maintain the operational fitness of the spacecraft at a level sufficient for conducting research of interplanetary space, as well as trajectory measurements.

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CSO: 1866/139

INTERPLANETARY SCIENCES

PARTICIPATION OF IKI'S FRUNZE SPECIAL DESIGN BUREAU IN 'VEGA' PROJECT

Frunze SOVETSKAYA KIRGIZIYA in Russian 11 Mar 86 p 3

[Article by L. Kondrashevskiy]

[Excerpt] One of the largest international experiments in space has been successfully completed. Processing and analysis of extremely valuable information received from the stations "Vega-1" and "Vega-2" lie ahead. But this is now the job of technicians, as specialists say. We now have every right to congratulate, on their great triumph, personnel of the Frunze Special Design Bureau of the USSR Academy of Sciences' Institute of Space Research who took part in equipping these stations with instruments.

(A photograph is given showing four participants in the "Vega" project working with research equipment. Among them are V. Aryamkin, head of a sector, and designers V. Lapteva and R. Shaykhulina.)

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CSO: 1866/139

'VEGA' MISSION SCIENTISTS MEET WITH GORBACHEV

Moscow PRAVDA in Russian 19 Mar 86 p 1

[Excerpt] On 18 March a meeting took place in the Kremlin between M.S. Gorbachev, General Secretary of the Central Committee of the Communist Party of the Soviet Union, and A.P. Aleksandrov, president of the USSR Academy of Sciences; Ye. P. Velikhov, vice-president of the USSR Academy of Sciences; academician R.Z. Sagdeyev, director of the Institute of Space Research and scientific director of the project; V.M. Kovtunenko, corresponding member of the USSR Academy of Sciences, chief designer and technical director of the project; Doctor of Technical Sciences, Professor Yu. A. Mozzhorin, director of work on ballistic calculations; and A.I. Dunayev, head of the USSR Main Administration for Development and Use of Space Technology for the Economy and Scientific Research.

The scientists told about the main results and most important features of the flight of the "Vega" automatic interplanetary stations. Two heavenly bodies--the planet Venus and Halley's Comet--were studied by the stations in the course of a single flight.

About 150 Soviet organizations and enterprises took part in work on the development of the "Vega" stations. Instruments, units and systems were designed and produced on the basis of the latest achievements in the fields of electronics, computer technology, scientific instrument building, materials science and technology. A large amount of experimental proving-out was done on the ground in conditions as close as possible to natural ones. Problems of ensuring the stations' encounter with Halley's Comet with high precision (in conditions of insufficient knowledge of the comet's coordinates), trouble-free functioning of the stations in conditions of intense impacts of meteorite dust, taking pictures of the comet in various spectra, and reliable transmission of pictures and information to the Earth on a real-time scale were solved successfully.

The accomplishment of this project is of great scientific and practical significance. New equipment, scientific instrument-complexes, promising materials and methods for processing large arrays of digital information which were developed and design and technological solutions which were adopted are being used and will be employed in future space-technology developments, and also in the interests of science and the economy.

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INTERPLANETARY SCIENCES

'VEGA' STATIONS CONTINUING FLIGHT

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 9 Apr 86 p 1

[Text] The flight of the Soviet automatic stations "Vega-1" and "Vega-2" is continuing. The majority of the scientific instruments installed on the stations have retained their operational fitness since passing through the gas-and-dust shell of Halley's Comet on 6 and 9 March. With the aid of these instruments, the structure and characteristics of interplanetary magnetic fields are being studied along the stations' flight paths, studies are being made of plasma phenomena, including measurements of parameters of the solar wind, and electrons and ions with various energies are being recorded.

Following the encounter with the comet, the television systems and electronic and optical elements of both stations are in good condition, which has been confirmed by results of picture-taking of the planet Jupiter with this equipment.

The stations "Vega-1" and "Vega-2" are now separated by a distance of 25 million kilometers, and they are continuing their flight around the sun. The distance of the spacecraft from Earth are 93 million and 181 million kilometers, respectively.

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CSO: 1866/139

TASS REPORTS ON 'ASTRON' SATELLITE, 'VEGA' SPACECRAFT

Moscow MOSKOVSKAYA PRAVDA in Russian 26 Apr 86 p 2

[TASS Report]

[Text] Deep Space Communications Center, 25 April. The astrophysical station "Astron," which was placed into a high elliptical orbit of an artificial Earth satellite on 23 March 1983, is now into its fourth year of operation.

Approximately 500 periods of radio communications have been conducted with the station in the course of its flight, during which time a variety of studies of stars, galaxies, nebulae and of Halley's Comet have been made in line with joint programs of scientists of the USSR, the GDR, France and Italy. With the aid of an ultraviolet telescope and an X-ray telescope which are installed on the "Astron" station, a number of important scientific results have been obtained: an unusually high content of superheavy elements has been discovered in the atmosphere of certain stars, a new type of stellar flares has been detected, previously unknown features of ultraviolet radiation of active galaxies have been revealed, and the nature of change in the rate at which matter flows out of very hot stars has been determined.

Information about Halley's Comet that was obtained from the "Astron" station is supplementing data of measurements made with the automatic interplanetary stations "Vega-1" and "Vega-2." According to specialists' estimates, Halley's Comet loses about 400 million tons of matter from its nucleus in one pass near the sun.

Following the completion of studies of the comet, the "Vega" stations are continuing to take measurements of characteristics and properties of the interplanetary medium. At the present time, the "Vega-1" station and the "Vega-2" station are 217 million and 198 million kilometers from Earth, respectively.

According to data of telemetry, the onboard systems and scientific instruments of the automatic stations "Vega-1," "Vega-2" and "Astron" are functioning normally.

FTD/SNAP
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CSO: 1866/139

BALLON PROBE AND DESCENT APPARATUS EXPLORATION OF VENUS DISCUSSED

Riga NAUKA I TEKHNIKA in Russian No 10, Oct 85 pp 5-8

[Article by Yuriy Zaytsev, department head, Space Research Institute: "Project 'Vega': First Stage of Research; Two automated interplanetary space station on the way to Halley's comet investigated Venus using balloon probes and descent apparatus"]

[Text] The automated interplanetary space stations "Vega 1" and "Vega 2," launched in December, 1984 toward Halley's comet, have completed the first stage in their planned flight program -- research on the planet Venus. The fly-by of Venus on the way to Halley's comet allowed us to use one space apparatus for immediately solving three problems. The first problem was the fundamentally new experiments in studying the circulation of the Venusian atmosphere and its meteorological parameters using a floating balloon probe. The second problem was research on the atmosphere, cloud layer and planetary surface using a descent apparatus. And, finally, the third problem was an investigation of Halley's comet from a fly-by trajectory.

The planet Venus occupies a special place in the Soviet space program. Not so much more than 20 years ago it was thought that Venus is the earth's "sister" - it's twin, that it's only a bit warmer there and that there's a hydrosphere and perhaps a biosphere there. But, alas, these hopes were not justified. Climatic conditions on Venus turned out to be too severe. Direct measurements from on board space vehicles have shown that the temperature at its surface is only a bit lower than 500°C, and of course, no oceans exist there because all the water would have evaporated long ago. However, the atmospheric density at the surface is only 14 times lower than the density of water.

The components of the atmospheres of our planet and Venus also differ. Why did these differences arise and how did the evolution of the atmospheres and climates of the neighboring planets occur? The answers to these and other questions will probably permit us to draw more correct conclusions about changes in the climate of our planet. Aside from climatological, there are also geological and cosmological aspects.

Evidence about the geological structure of the solid bodies of all the planets of the earth group (in which Venus is included) is necessary to recreate the conditions of the early stages of the earth's evolution, with which the processes for the formation of natural resources are directly related.

For space research directed at clarifying the origins and development of the solar system, the most valuable evidence is contained in the contents of the atmosphere, in particular, evidence on the quantity of inert gases and their isotopes, because many of them are residual -- they have been left over from the times of the planet's formation. The study of Venus is conducted taking all three aspects into account. More than 10 space vehicles have operated in the Venusian atmosphere and on its surface. Five artificial satellites, sent from earth, are in orbit around the planet. Interesting results were obtained, for example, from two of the later vehicles, the "Venera-15" and "Venera-16." For the first time from the orbit of an artificial satellite measurements were made of the spectral composition of the planet's infrared radiation. It was determined that the structure of clouds at various latitudes differs. For example, the concentration of particles in the middle latitudes is five times lower than at the polar latitudes. It was also found that the upper boundary of clouds is from 72 to 65 km. In the polar region there are so-called "hot spots" of about 1,000 km across. The flow of emanating warm radiation from these is 20% greater than at the equator.

A full interpretation of all the data obtained using spectrometers will take several years, evidently since the volume of material is great and a nonstandard solution must be sought for analysis of the new information.

With the help of "Venera-15" and "Venera-16" an extensive radar picture was obtained of the planetary surface in its north polar region. Now many of the riddles of Venus have been solved, one might say. Nevertheless, many matters remain unclear. With assistance of integrated research from the "Vega 1" and "Vega 2" space stations, it is intended that they be solved.

In the six months of their flight, having covered a distance of nearly 500 million km, the space stations reached the neighborhood of Venus at the beginning of June. Two days before the fly-up directly to the planet, descent vehicles were separated from the space stations, which upon entry into the planetary atmosphere divided into a landing apparatus and a balloon probe. This occurred in the following way:

A displacement of its center of gravity provides the needed orientation to the descent apparatus in motion. After its second stage is extinguished on signals of an overload sensor, the lid to the parachute container shoots off and its separation chute begins to function. Then the heat-protective sphere is cut in half by the detonation of a circumferential explosive charge. The upper half of the sphere is shot off together with a balloon probe. After the probe release, the first stage of the balloon parachute system goes into action. The probe moves on its stabilizing parachute. It brakes the apparatus and having performed its task, "passes the baton" to the balloon's deployment chute. This is the primary large parachute with a surface of 35 square meters that finally brakes the container to the necessary speed. Explosive charges, detonating, open up the balloon container and it divides into two halves. The lower part, descending, stretches out the soft balloon envelope and extends the gondola. Then an access to helium opens up from tanks into the balloon. The balloon takes 250 seconds to fill. Explosive charges separate the parachute together with part of the balloon container and the helium tanks. Ballast is jettisoned and the balloon rises to drift altitude.

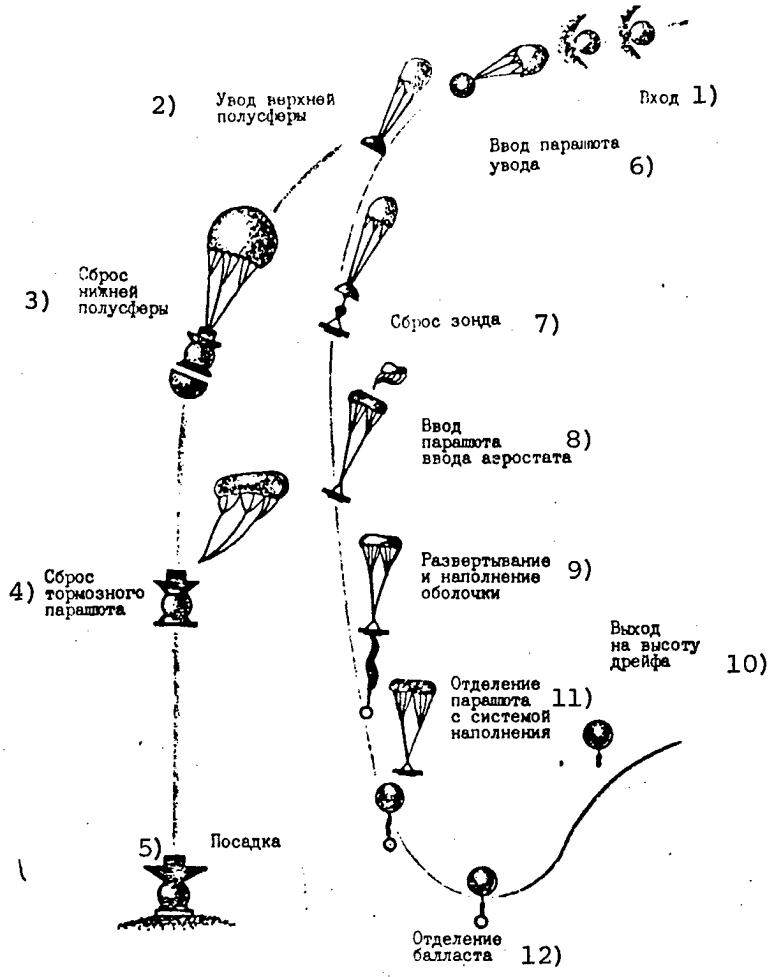


Diagram of motion and restructuring of descent vehicles in Venusian atmosphere.

KEY:

1. Entry
2. Release of upper hemisphere
3. Shooting-off of lower hemisphere
4. Release of braking parachute
5. Landing
6. Activation of release of probe
7. Release of probe
8. Activation of parachute for balloon operation
9. Deployment and filling of envelope
10. Reaching of drift altitude
11. Separation of parachute and filling system
12. Separation of ballast

While this is occurring, the lower half, together with the landing apparatus, descends on a braking parachute to an altitude of 63 km. There it separates from the landing apparatus and after another kilometer, when the rate of descent dereases to 20 m/s, the braking parachute is also jettisoned. Thereafter the braking of the descent apparatus will occur via an aerodynamic shield.

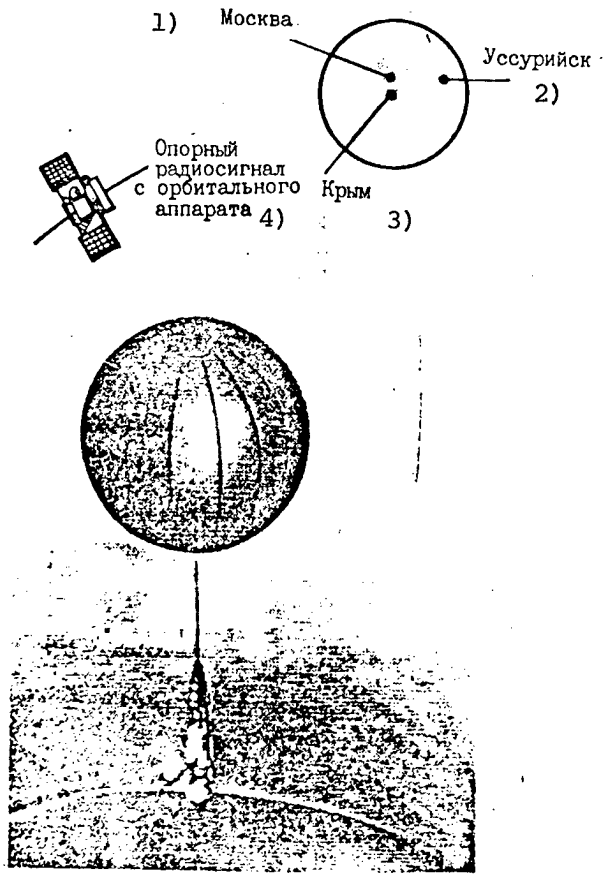
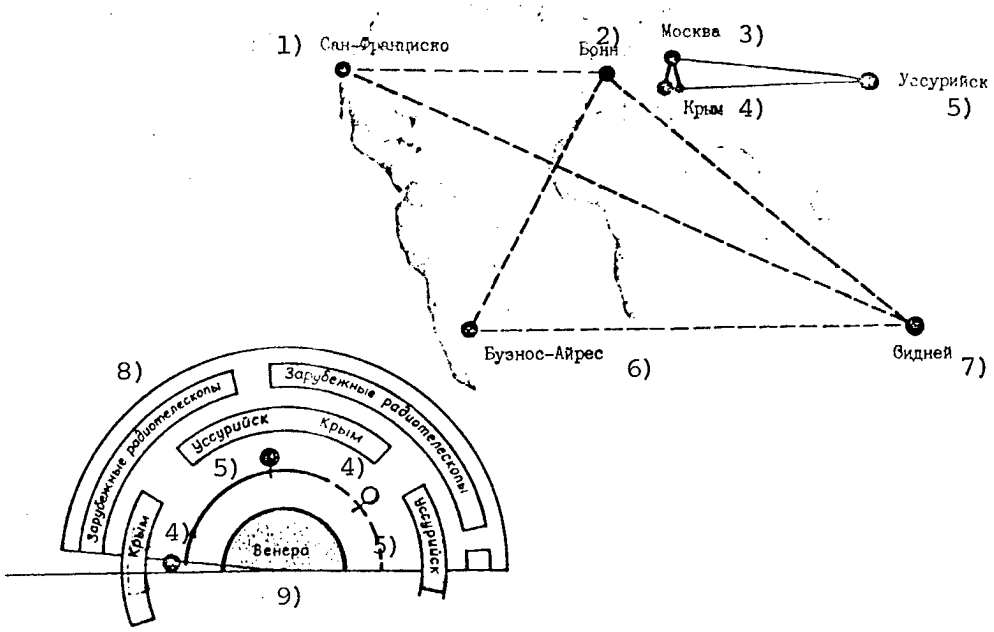


Diagram of "Aerostat" (Balloon) experiment.

KEY:

1. Moscow
2. Ussuriysk
3. Crimea
4. Control radio signal from orbital vehicle

At the moment when the apparatus hits the ground its rate of descent is about 7 m/s. The impact force is cushioned by a special device in the form of a thin-walled plastic toroidal bag which deforms on landing. It provides an oriented position of the apparatus on the planetary surface. Both balloons crossed over from the planet's dark side to its illuminated side under the influence of the wind. Over the course of 46 hours information on about more than 10,000 km of flight path was transmitted to the earth as one balloon passed along the equator in the northern hemisphere and the other along the equator in the southern hemisphere at an average speed of about 250 km/hour. A balloon sounding of the Venusian atmosphere was made for the first time in world experience and its significance is hard to overrate. It permits us to answer highly important questions about the planet's physics which could not be solved with landing systems. It is known, for example, that in the Venusian atmosphere something like a global low-pressure system is operative which completely encircles the planet once every four days. It is still unclear what maintains such a rapid rotation of the atmosphere. The temperature on the illuminated and dark sides of the planet is virtually identical, so warm overcurrents are excluded. Venus rotates about its axis very slowly and at its surface the wind speed, measured by landing apparatus, as was expected, is not great: about 1 m/s. Research on circulation of the Venusian atmosphere has practical importance since it permits us to understand better the dynamics of our own atmosphere and to clarify the mechanisms of long-term variations in the earth's climate. But to do this it is necessary to know the physical principles and consequences of similar processes on Venus. In other words, aside from the movement of the atmosphere itself, scientists are interested in its fields of temperature and pressure, its optical characteristics, the horizontal and vertical structure of its cloud layer, and so on. Rather fundamental information on these questions should have been given by research on Venus with the help of balloons.



Observations of motion of balloon in planetary atmosphere are made using a global interferometer which consists of the 7 largest radio telescopes in the world.

KEY:

1. San Francisco
2. Bonn
3. Moscow
4. Crimea
5. Ussuriysk
6. Buenos Aires
7. Sydney
8. Foreign radio telescopes
9. Venus

The balloon probe consists of a balloon with an envelope made of fluoroplastic varnished fabric of 3.4 m in diameter and a gondola which is slung on a 12-m halyard. The gondola carries meteorological instruments, power sources (chemical batteries) and radio transmitters. From the complex of meteorological instruments every 75 seconds readings are registered in the memory on the measurement of atmospheric temperature and pressure, the vertical component of wind velocity and the optical density of the cloud layer. The volume of data collected over the preceding 30 minutes is transmitted to earth.

The largest radio telescopes in the world, integrated for interferometry, receive signals from the probes and determine their position in the expanse and their velocity of motion.

The essence of the interferometric method is that observations are made simultaneously by two or more radio telescopes located as far from one another as possible. The angular resolution of the observations in this case is not determined by the size of the antennas but by the distance between the telescopes. The resolution which is obtained is 1,000 times better than optical telescopes, which make it possible to track the motion of a probe along the Venusian plane reliably.

Two networks of radio telescopes were established: a Soviet network, coordinated by the Space Research Institute, USSR Academy of Sciences, and an international network, coordinated by the French National Space Research Center. The Soviet network consists of the 70-m radio telescopes at Ussuriysk and Yevpatoriya, the 64-m radio telescope at Medvezhiye Ozera (near Moscow), the 22-m radio telescopes at Pushchino (on the Oka River) and Simeiz (Crimea) and the 25-m radio telescope at Ulan-Ude.

The international network consisted of radio telescopes with an antenna diameter of 64 m at Goldstone (USA), Canberra and Parkes (Australia) and Madrid (Spain), the 100-m radio telescope at Eifelberg (FRG), as well as a number of intermediate-sized telescopes in Europe, North and South America and in the south of Africa. The scientific instruments for meteorological measurements on the balloons were developed at the Space Research Institute, USSR Academy of Sciences. French scientists, and together with them, as a sort of "subcontractors," American specialists, participated in these experiments in the capacity of partners. The fact is that the United States is not included in the "Vega" project. The American administration has ceased cooperative work with the Soviet Union in the area of space research. However, American scientists, interested in continuing this cooperative work, joined the project under the aegis of the scientific agencies of France and the FRG.

The full processing of the data from the experiments with the balloon probes will be accomplished by a group of scientists from the USSR, United States and France. It is expected that the scientific results will be finalized only toward January 1987, so great is the volume of collected data. Therefore, today it is only possible to speak about preliminary data.

First and foremost, exceedingly strong vertical wind gusts were registered which attained more than a meter per second. (On earth these do not exceed several centimeters per second.) This is evidence of strongly developed turbulence in the Venusian atmosphere in the zone of balloon flight, that is, at an altitude of about 54 km. On the dark side of the planet the instrumentation detected illumination variations and light flashes. What this might be is still unclear. Perhaps lightning. In fact, thunderstorm phenomena in the Venusian atmosphere were discovered by the apparatus from the "Venera 11" and "Venera 12" stations. Or volcanic eruptions. Or maybe both? In any event, the sulfur dioxide content in the Venusian atmosphere might be attributable to volcanic eruptions.

One thing is clear: the balloon experiment is one of the most important scientific-technical achievents of Soviet astronautics. It affords new opportunities for research not only on Venus, but on the other planets as well.

While the balloon probes were drifting in the Venusian atmosphere, the landing apparatus descended to the planetary surface. Scientific research began immediately with their launching. Immediately after the opening of the braking parachute, an instrument was switched on for measuring atmospheric pressure, average temperatures and their fluctuations. One of the main objectives of the research was more clearly ascertaining the photochemical processes which correspond to formation of the Venusian cloud layer. On the basis of related data

obtained earlier it was postulated that it consists mainly of sulfuric acid (75%-85% concentration) with traces of chlorine. Nevertheless, until then there was no direct determination of sulfuric acid in the cloud layer. It is also unclear in what form chlorine is present in the clouds. Research was carried out with an instrument complex. Immediately the "Sigma-3" gas chromograph ascertained with certainty the presence of the chemical compound sulfuric acid in Venusian clouds.

An ultraviolet spectrometer for the first time measured the absorption of atmospheric gases at altitudes from 60 km down to the surface. Special analyzers installed aboard the descent apparatuses enabled us to determine not only the diameter of each individual particle of the cloud layer, but also to evaluate their form. Every second data on seven randomly selected particles were transmitted to earth. We succeeded in determining that the quantity of particles measuring on the order of five microns comprises approximately 100 per cubic centimeter, but lower than 40 km -- up to 1,000/cm^3. Moreover, the size of the particles decreases. Lower than 40 km their diameter is less than a micron.

Another instrument, a so-called phase transition indicator, determined, using a radio X-ray method, the elemental composition of the cloud layer and gave information about aerosol density in relation to altitude. The density, in turn, contains information about the structure of the cloud layer. It was found to be complex and stratified. Thus, the "Vega 1" descent apparatus discovered no less than five cloud layers.

Suppositions arose that iron compounds are present in Venusian clouds. The landing apparatus of the "Vega 2" station performed an analysis of the chemical composition of ground material: concentrations of the main rock-forming elements from magnesium to iron inclusive were found, as well as a few heavier rare elements. Research was conducted by the method of radio x-ray analysis, which is based on the relation of rays emitted by isotope sources to the content of an element in the sample.

The chemical composition of the ground material was determined by this method for the first time in 1982 by the "Venera 13" and "Venera 14" stations. The landing site of the new apparatus is many hundreds of kilometers from that of the previous ones and it is, for the first time, in a high-mountain region, which gives us an opportunity, on the one hand, to judge how widely varied the rocks on Venus may be, and on the other hand, to construct more precisely a model of the chemical interaction of the surface with the atmosphere. The first data have already shown that the soil composition there differs from that discovered at the previous landing points.

Due to the launching of the new Soviet automated space stations, many problems in studying our closest neighbor, Venus, a planet of the earth type, have succeeded in being resolved.

12961
CSO: 1866/24

UDC 523.42

ROLE OF TURBULENCE IN ENERGETICS OF NIGHTTIME VENUSIAN THERMOSPHERE

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 19, No 4, Oct-Dec 85 (manuscript received 17 Jul 85) pp 289-295

[Article by B.F. Gordinets, and Yu. N. Kulikov, Physics Institute imeni P.N. Lebedev, USSR Academy of Sciences; Applies Mathematics Institute imeni M.V. Keldysh, USSR Academy of Sciences]

Abstract] The objective of this study was clarification of the role of turbulence in the heat balance of the Venusian nighttime thermosphere and a determination of the principal turbulence parameters ensuring agreement between theory and experiment. The authors formulated a one-dimensional stationary model which in the neighborhood of the antisolar point makes it possible to compute vertical profiles of temperature and the concentrations of CO_2, CO, O, H_2O, N_2 and He. In an earlier article in PISMA V ASTRON. ZHURN., Vol 10 No 9, pp 696-701, 1984 the authors described the main features of the model and radiative heat losses due to IR radiation in the CO_2 band 15μm, in the H_2O and CO rotational bands, in the line 63 μm of atomic oxygen and also heating due to the convergence of the velocity U of the zonal wind. The proposed theoretical model, with allowance for turbulence and its heat balance, on the basis of measurements of density and composition, by means of solution of the inverse problem makes it possible to ascertain the principal parameters characterizing turbulence. The theory agrees well with experimental data and reveals the important role of turbulent thermal conductivity and the dissipation of turbulent energy in the heat budget of the nighttime Veusian thermosphere. Figures 2, tables 1; 15 references: 5 Russian, 10 Western.

[47-5303]

METHOD, APPARATUS AND RESULTS OF DETERMINATION OF ELEMENTAL COMPOSITION OF VENUSIAN ROCK BY 'VEGA-2' SPACECRAFT

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 19, No 4, Oct-Dec 85 (manuscript received 23 Jul 85) pp 275-288

[Article by Yu. A. Surkov, L.P. Moskaleva, L.P. Shcheglov, A.D. Dudin, V.P. Kharyukova, O.S. Manvelyan, G.G. Smirnov, V.L. Gimadov, S.S. Kurochkin and V.N. Rasputnyy, Institute of Geochemistry and Analytical Chemistry imeni V.I. Vernadskiy]

[Abstract] The elemental composition of Venusian rock in the northern part of Aphrodite Terra was determined using the X-ray-fluorescent spectrometer carried on the landing module of the "Vega-2" spacecraft. The article describes the method and instrumentation used and the results of determination of the elemental composition of the rocks. The best correspondence between Venusian rocks and those of the Earth's crust is with troctolite, anorthosite and those of close composition. In the northeastern part of Aphrodite Terra there are rocks closest in composition to rocks of the anorthosite-norite-troctolite group which constitute the basis for the lunar continental crust. Data are available on the types of magmatic rocks situated within the limits of the principal geological-morphological provinces of Venus corresponding to the tectonic and magmatic stages in its development. These include hilly elevations made up of slightly differentiated alkaline basalts, smooth lowlands covered with volcanic tuff and tholeiitic basalts, recent shield volcanic structures apparently also close in composition to tholeiitic basalts and high mountains with rocks hypothetically close in composition to the anorthosite-norite-troctolite group. Therefore most of the Venusian surface is covered by different basaltic rocks and only an insignificant part by anorthosite-norite-troctolite rocks. This resembles the lunar surface, although the ratio of areas of basaltic seas and the continental crust is different. The results of study of the Moon, Mars and Venus strongly suggest that a primary feldspathic crust probably also existed on the earth in an early epoch. Figures 5, tables 1; references 10: 7 Russian, 3 Western. [47-5303]

UDC 523.45

JOVIAN DECAMETER RADIO EMISSION. I. MORPHOLOGY OF S-STORMS

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 19, No 4, Oct-Dec 85 (manuscript received 11 Dec 84) pp 296-318

[Article by B.P. Ryabov, A.V. Arkhipov and V.A. Shevchenko, Radio Physics and Electronics Institute, Ukrainian Academy of Sciences]

[Abstract] The decameter sporadic radio emission of Jupiter in the range hundreds of kHz to 39.5 MHz consists for the most part of wide-band noise storms of two types L and S. The objective of this study is a determination of the detailed structure of the directional diagram of the S-component of Jovian emission and correlation of the parameters of S-storms with various characteristics of the Jupiter-Io system. This necessitated qualitatively new observations for obtaining macroscale dynamic spectra of S-storms. This problem does not require high frequency-time resolution, but requires registry of extremely weak flux densities in the widest possible frequency range and continuous tracking of the planet for several hours. Such a study was made using the UTR-2 decameter radio telescope, which is described in detail as applicable to this particular problem. The observations were made in February-March 1980 and 1981 on 14 nights and in March-April 1982 on 39 nights. The observations were made when the time of culmination occurred late at night. S-storm spectra were obtained for the total duration of each storm. The minimum recorded flux density occurred on 10 January; tracking time was 8 hours. The probability of occurrence of S-emission has a periodic dependence on observation frequency (period 3.5 MHz). S-bursts appear with almost all longitudes of the central meridian and almost all phase angles of Io. The appearance of powerful S-storms is completely controlled by the position of Io in orbit. All S-storms experience group frequency drift. Drift velocities vary from one storm to the next. The conical directional diagram for the S-component has a frequency-dependent angular structure. Figures 6, tables 1; references 27: 6 Russian, 21 Western.
[47-5303]

UDC 523.6

COMETARY NUCLEI WITH MULTIPLE STRUCTURE FROM OORT CLOUD AND GENERAL MODEL OF ORIGIN OF PARTICULARLY ACTIVE COMETS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 5, Sep-Oct 85 (manuscript received 15 May 85) pp 766-782

[Article by V.D. Davydov]

[Abstract] The imperfection of some principles of the modern theory of a cometary nucleus is evidenced by the endless flow of hypotheses, many in contradiction to experimental data. A new concept has been formulated which is a result of integration of suitable hypotheses into a general model. The new model provides a general solution of the entire problem of the origin of active comets simultaneously from the points of view of astrophysics and celestrial mechanics. The elements of this model are: evolution of the system of nucleus satellites to a collisionless structure, cosmologically prolonged conservation of the internal mechanical energy in the collisionless system and tidal activation of the shock wave mechanism in the first return of an ancient multiple nucleus to the visibility zone. Such returns possibly correspond to the appearance of particularly active comets in almost parabolic orbits. The multiple structure of the nucleus of particularly active short-period comets could be inherited from comets with almost parabolic orbits. The proposed model of the origin and evolution of the structure of a cometary nucleus provides the simplest key to understanding of the mechanism of cometary division and suggests the possibility of their solar-tidal division at greater distances from the sun than postulated earlier. Among the corollaries following from this concept are several which can be readily checked, such as the formation of almost parabolic cometary chains from the former satellites of each multiple nucleus. These considerations and others are indicative of a need for reexamining the question of the total surface of matter in the Oort cometary cloud. References 45: 18 Russian, 27 Western.

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A PRIORI ACCURACY IN PREDICTING POSITION OF HALLEY'S COMET USING SURFACE AND SPACECRAFT MEASUREMENTS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 6, Nov-Dec 85 (manuscript received 10 Jul 84) pp 876-885

[Article by B. Ts. Bakhshiyan, A.A. Sukhanov and P. Ye. Elyasberg]

[Abstract] Two "Vega" spacecraft were launched in the USSR in December 1984. In March 1986 they were to investigate Halley's Comet at a close distance. A study was made to evaluate the accuracy in predicting the geocentric position of the nucleus of Halley's Comet when using optical observations of the comet from the earth and from aboard the "Vega" spacecraft. The evaluated parameters were the T and R coordinates of Halley's Comet in the plane of reference of the "Giotto" spacecraft during their rendezvous on 14 March 1986 (the T axis lies in the plane of the ecliptic and the R axis is directed perpendicular to T). A method for computing the accuracy of prediction was developed with quite general assumptions concerning errors in initial data. It was found that the position of the comet at the time of its rendezvous with the "Giotto" satellite, with allowance for observations from the "Vega" spacecraft, can be predicted with accuracies σ_T = 30-110 km, σ_R = 70-125 km. The main influence on accuracy in predicting position of the comet is exerted by the error in determining its velocity. The greatest accuracy in predicting cometary position by use of spacecraft observations would be achieved 2 minutes after approach of the "Vega" spacecraft to the comet. However, it is infeasible to use cometary observations from both "Vega" spacecraft because it would give no increase in accuracy in predicting its position in comparison with observations by "Vega-2" alone. Use of observations from "Vega-2" will result in an increase in accuracy in prediction in comparison with use of "Vega-1" observations by 25-30 percent. Figures 3; references 7: 5 Russian, 2 Western.

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KIRGIZ SCIENTISTS WORK ON 'ADAPTOGEN' MEDICATIONS FOR COSMONAUT ADAPTATION

Frunze SOVETSKAYA KIRGIZIYA in Russian 12 Apr 86 p 4

[Article by A. Altymyshev, academician, member of the presidium of the board of the All-Union Scientific Society of Pharmacologists]

[Excerpt] Remarkable preparations have been developed in Kirgizia. They are adaptogens--medicines which help people become acclimated to extreme conditions quickly, orient themselves in these conditions, and endure them more easily.

In the early days, cosmonaut training proceeded along two lines. One of them was experimental physical conditioning in laboratories, using various apparatus and gear. The other was conditioning in natural conditions of high elevations, making use of oxygen deficiency factors.

At that time, scientists of Kirgizia were studying the scientific problem of high elevations and adaptation to their conditions. Among the pioneers of this direction were professors K. Chukin, M. Aliyev, A.B. Tilis, B. Turusbekov, Yu. A. Slonim, V. Isabayeva, M.M. Mirrakhimov, M. Turkmenov, A. Agadzhanyan, A. Aydaraliyev and D. Alymkulov. Scientific results of their work played a tremendous role in the further conditioning of cosmonauts.

Kirgizia also was and still is an area for the conditioning of cosmonauts. As time passed, oxygen-deficiency factors, blood indicators and other health indicators of cosmonauts who trained in the republic were found to be physiologically more suitable for the health of cosmonauts. The Lake Issyk-Kul area, which is at a high elevation, was selected for the further conditioning and rest of many cosmonauts.

Another scientific direction was being pursued at the same time--a search for medicines which would accelerate the adaptability of cosmonauts. The author of this article worked on the development of adaptogens under the direction of academician S.V. Anichkov in Leningrad at first. This scientific direction was carried on subsequently in collaboration with academician O.G. Gazenko, I.P. Neumyvakin, V.S. Shashkov, O.I. Gorelkina, Ye. P. Zotov, M.A. Orozov and Sh. N. Khabibrakhmanov. One adaptogen after another was developed.

Scientific contacts with cosmonauts grew stronger from year to year. Projects of scientists of Kirgizia were included also in the "Intercosmos" scientific program. Adaptogens called "Gipkos" and "Gipreks," leophyllized juices and other products were then introduced with great success. These preparations accelerate the adaptive capabilities of cosmonauts, improve the functioning of individual organs and the organism as a whole, and contain components that are necessary for human life.

The Cosmonautics Federation has awarded medals named for Academician S.P. Korolev to Kirgiz scientists for their scientific and practical contribution to space exploration, and these scientists have been awarded silver and bronze medals for development of adaptogens that have been exhibited in the "Space Research for the Economy" pavilion of the USSR Exhibition of National Economic Achievements.

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LIFE SCIENCES

SPACE EXPERIMENTS WITH COTTON PLANTS TO CONTINUE

Tashkent PRAVDA VOSTOKA in Russian 6 Mar 86 p 6

[Article by R. Shagayev, correspondent]

[Excerpt] USSR pilot-cosmonaut Vladimir Dzhanibekov proposed that experiments with cotton plants be included in a biological program of space research. A container holding seeds of fine-fibered and medium-fibered varieties from the collection of the Uzbek Academy of Sciences' Institute of Experimental Plant Biology was loaded onto the spaceship "Soyuz T-13," which set out on a four-month space mission in June of last year.

Following the completion of this mission, sprouts from these seeds were returned to a hothouse of the Tashkent institute. Associates of the laboratory of cytoembryology and cellular engineering, which is headed by Candidate of Biological Sciences A. Ergashev, have been observing the sprouts carefully. These scientists are studying the adaptation capabilities of the cotton plant, effects of zero gravity on heredity, and other properties of the plants. Collaboration between Uzbekistan biologists and space researchers is advancing. In accordance with a decision, seeds obtained from the present crop of plants that traveled in space are also to be sent on a mission, for the purpose of continuing the experiments.

(Two photographs are given showing cotton-plant seeds which have been in space, in a container; and A. Ergashev and A. Abdullayev, corresponding member of the Uzbek Academy of Sciences and scientific consultant for an experiment, examining cotton plants which were planted in space.)

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FOURTH PARIN LECTURES ON SPACE MEDICINE

Moscow MEDITSINSKAYA GAZETA in Russian 9 Apr 86 p 3

[Text] Problems of adaptation of humans in space, of restoring their working fitness after prolonged periods spent in weightlessness, and other aspects of space medicine were examined at lectures which were held at the Moscow House of Scientists. The lectures honor the memory of academician V.V. Parin, who stood at the cradle of space medicine.

Papers were presented by scientists of the USSR Academy of Sciences, the USSR Academy of Medical Sciences, and the USSR Public Health Ministry's Institute of Medical-Biological Problems. The main theme of the Fourth Parin Lectures was "For Space To Be Placed at the Service of People, We Must Learn How to Live in It."

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LIFE SCIENCES

WORK ON PLANT SELECTION FOR MANNED SPACEFLIGHT

Moscow NEDELYA in Russian No 20, 12-18 May 86 pp 4, 5

[Article by Nadezhda Yurchenko (Kiev)]

[Abstract] The author visited the Ukrainian Academy of Sciences' Central Republic Botanical Garden and interviewed Doctor of Biological Sciences Tatyana Mikhaylovna Cherevchenko, deputy director of the garden in charge of scientific work. She commented on scientific work in support of the space program.

Experiments here are aimed at selecting plants for manned spacecraft which can serve as a source of food and oxygen and can purify the air inside the spacecraft, according to Cherevchenko. Such plants must be capable of taking root, developing and producing off-spring in conditions of prolonged dynamic weightlessness. They must withstand dry soil and atmosphere fairly well, and they must produce no allergenic effects. In experiments conducted on the ground, two species of epiphytic orchids were found to meet these requirements best. Effects of zero gravity on the development of these species were then studied in space experiments.

Cherevchenko commented on results of these experiments. Epidendrum orchids were grown successfully in a special container, "Malakhit," which was delivered to the orbiting station "Salyut-6" by the crew of the spaceship "Soyuz-35"--L. Popov and V. Ryumin. These plants were grown in a synthetic counterpart of soil which Belorussian scientists developed. Work on improving this soil substitute reportedly is being done at the Ukrainian Academy of Sciences' Institute of Physics. Slow-acting fertilizers for the plants were developed at the UKrainian Agricultural Academy. These fertilizers were placed in special capsules whose shells dissolve at a prescribed rate of time, which can take as long as several months. Some of the plants on board "Salyut-6" were returned to Earth after 60 days; others spent periods of 110 and 170 days in orbit.

Cherevchenko mentioned in conclusion that she and her colleagues are now working on selecting vegetable plants which will be able to pass through a complete cycle of development in space.

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INTERVIEW ON MEDICAL PROGRAM OF 237-DAY FLIGHT

Moscow ZEMLYA I VSELENNAYA in Russian No 5. Sep-Oct 85, pp 49-56

[Interview by correspondent V. B. Pishchek with Oleg Yuryevich Atkov, hero of the Soviet Union, pilot-cosmonaut of the USSR and candidate of medical sciences, Oleg Georgiyevich Gazenko, academician and director of the Biomedical Problems Institute, and Yevgeniy Ivanovich Chazov, academician and director of the All-Union Cardiological Science Center, under the rubric "Our Interviews": "There is a Doctor in the Space Crew"; date and place of interview not given; source introduction and questions printed in boldface]

> [Text] The crew of Mayaki [Beacons]--L. D. Kizim, V. A. Solovyev and O. Yu. Atkov--spent 237 days working on board the Salyut-7 - Soyuz orbital scientific research complex.
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> An intensive program of medical and biological research was carried out. Participating in the preparations for the program were specialists from the USSR Ministry of Health's Biomedical Problems Institute, the USSR Academy of Medical Sciences' All-Union Cardiological Science Center, the Cosmonaut Training Center [CTC] imeni Yu. A. Gagarin, and a number of other institutions. Our correspondent, V. B. Pishchek, asked O. YU. ATKOV, hero of the Soviet Union, pilot-cosmonaut of the USSR and candidate of medical sciences, O. G. GAZENKO, academician and director of the Biomedical Problems Institute, and YE. I. CHAZOV, academician and director of the All-Union Cardiological Science Center, to tell about the execution of this program in space and about some of the results of the research and experiments conducted.

[Question] The first question is for you, Oleg Georgiyevich and Yevgeniy Ivanovich. This is the first time that a doctor has worked for such a prolonged period of time in orbit. You could say that specialists in the field of space medicine were receiving first-hand information. How much has this expanded the customary boundaries of medical monitoring and research carried out in space?

O. G. Gazenko: In my opinion space medicine had not received as much information in any one of the previously conducted space flights as it has from last

year's flight of our Mayaki, which was completed in October and was the longest in history. More than 30 medical tests and experiments were conducted and considering that many of them were repeated several times, then the total number is more than 200. This is primarily due to the fact that there was, working as a crew member, an authoritative representative of space medicine and a doctor--a highly qualified specialist--Oleg Yuryevich Atkov.

Ye. I. Chazov: The equipment and methods of "remote diagnosis," developed by space medicine, give medical personnel and excellent opportunity in the course of the flight to receive on the ground, via the telemetry channels, a large quantity of physiological parameters describing the cosmonauts' state of health.

At the same time the participation of a doctor in a prolonged space expedition opened up principly new opportunities for uninterrupted medical observation and introspection, for first-hand evaluation of the health and efficiency of all the crew members in a circumterrestrial orbit, and permitted a new and more thorough method of conducting many medical tests and experiments.

[Question] Oleg Yuryevich, what did your work as a doctor-researcher consist of in the course of the flight?

O. Yu. Atkov: The work of a doctor during a space flight can, of course, be somewhat conditionally divided into two interrelated assignments--medical monitoring and biomedical tests and experiments. In the final result the tasks of both assignments are one and the same: to evaluate the crew's state of health and to continue gathering data on the effects of a prolonged stay in space on the human body.

Inasmuch as the crew members' state of health was good over the extent of the entire flight, the regular medical check-ups were mainly of a preventive medicine nature. For all practical purposes, (if you ignore the fact that they were conducted in a weightless state) they did not differ in the least from the type each of us encounters whenever we visit a doctor's office: the skin and the mucous membranes are examined; the heart and lungs are listened to; blood pressure and pulse readings are taken; and muscle reflexes are tested.

Otolaryngial and ophthalmological examinations were conducted several times, which permitted objective data on the dynamics of the blood supply of the nasopharynx, of the eardrum and of the eye at different periods of adaptation to weightlessness to be obtained. For the hematological, biological and immunological tests blood samples were taken from a finger and a vein.

The medical check-up also included an evaluation of the crew members' mental state, of their diet and of their work and rest routines (based on my recommendation, at the end of the flight the ground increased our rest period by an hour), as well as the conducting of biological and sanitation and hygiene tests.

[Question] The carrying out of this work undoubtedly required suitable equipment and instruments. Just what did the doctor have available at the time of the flight?

O. G. Gazenko: On board the orbital station there is a set of medical chests for various purposes, which include a large number of medicinal preparations, as they say, for all occasions, beginning with medicine for headaches, colds and insomnia, and ending with the means for rendering aid in the event of bleeding, burns or trauma. A list has been placed into each chest describing the preparations contained in it and with instructions on when and how to use them. Taking into consideration the fact that a doctor was part of the crew, more medical chests were placed on board the station, with equipment for conducting medical tests, as well as a set of instruments for rendering urgent ophthalmological or stomatological aid, if need be. Fortunately, there were no cases of illness during the flight and the need to turn to the medical services of the doctor was extremely rare.

Ye. I. Chazov: It must be noted that O. Yu. Atkov had available on board the station an abundant arsenal of medical equipment, combining a high degree of informativeness, compactness and reliability. The multifunctional AELITA device permitted the recording of a large number of physiological parameters defining the activities of the body's cardiovascular and respiratory systems. Ultrasonic locating of the heart, the large vessels and the internal organs was accomplished with the aid of the ARGUMENT and EKHOGRAF devices. Qualitative analysis of several electrolytes in blood samples was performed on a first-hand basis in space on the BIOKHIM device. These electrolytes define the condition of the body's primary metabolic processes. Using the PLAZMA device, by means of a centrifugal procedure, blood taken from a vein was separated into its regular elements and plasma, and then the blood samples were preserved for subsequent intensive biochemical analysis under laboratory conditions on the ground. The functions of the eye were studied by means of the NEPTUN and MARS devices and mental efficiency was studied using the BALATON device... Briefly, the doctor had at his disposal a valuable consultation room for functional diagnosis, one which, if you will, was second to none on the ground.

O. Yu. Atkov: I would like to express my most sincere gratitude to all the developers of this remarkable equipment.

[Question] As Oleg Georgiyevich has said, more than 200 biomedical tests and experiments were conducted in orbit. Please reflect on the more important directions of the medical program conducted during the flight.

O. Yu. Atkov: In the course of the flight a large volume of tests was conducted on the cardiovascular system. This system is one of the principal "targets" of the effects of weightlessness. First, I want to touch on the tests in which ultrasonic locating of the heart and large vessels was used and which permitted us, as it were, to look inside the heart and to obtain an idea of the condition of its cavities and main vessels, of the operation of the valves and of the condition of the heart muscles. At the same time, the heart's bioelectrical activity was studied, including its daily dynamics when at rest and during physical exertions, as well as the reactions of the cardiovascular system when the lower half of the body was subjected to negative pressure.

Ye. I. Chazov: I would like to note that Oleg Yuryevich has for a long time

and with a high degree of success been dealing with questions concerning the introduction of echocardiographic methods into clinical practice. He was the first person in our country to use the two-dimensional echocardiographic method to investigate the anatomy and functioning of the heart on a practical time scale. He was awarded the Komsomol's Lenin prize for the development and introduction of ultrasonic methods of diagnosis of major heart diseases.

We have been using the method of ultrasonic locating of the heart over a period of several years now before, during and after the cosmonauts' flight examination and during ground laboratory test designed to simulate (let's say, under conditions of hypokinesia) some of the physiological effects of weightlessness. Oleg Yuryevich took part in these tests, as well as in the development of the Argument equipment.

O. Yu. Atkov: In order to more thoroughly study the metabolism, functional load tests were used. For example, to evaluate the characteristics of carbohydrate metabolism during an extended stay in weightlessness we conducted a functional test using a glucose load. For the first time during a space flight the load test method was also used to evaluate calcium metabolism. The results of the test for the level of immunoglobulins in the blood serum will aid in the investigation of many questions associated with changes in the body's immunological reactivity, which have been noted during prolonged flights.

O. G. Gazenko: The functional test method permits a more detailed study of the metabolic processes than was previously possible, in particular, the mechanism for increased removal of calcium from the body and the reason for the demineralization of bony tissue under the conditions of weightlessness. For the time being, even during the most prolonged flights, the calcium loss and the associated changes in skeletal strength have not risen to a dangerous level. But, in order to completely eliminate any possible undesirable consequences, we should study the mechanism of the phenomenon from all sides.

Ye. I. Chazov: The MEMBRANA experiment conducted during the flight on a special biological model was devoted to solving this problem. The basic goal of this experiment was to attempt to investigate the mechanism of the changes in the permeability of the cellular membrane and the associated "leakage" of calcium from the cell, as well as the associated disturbance in the balance between the amount of calcium in the cell and in the intercellular fluid. The processing of the data from this experiment has not been completed yet, although it appears that the results will be greatly significant, not only for space medicine, but also for clinical practice on the ground as well.

O. YU. Atkov: A significant spot in the medical program was alloted to the study of the activities of the analyzers , in particular the eye. Tests were conducted on the color vision threshold, the depth vision threshold and the resolution of the eye, as well as on its muscles and retina. In order to investigate the reasons for motion sickness, which occurs during flights, and to determine the corresponding preventive measures, we analyzed the characteristics of the interaction between the vestibular and visual analyzers during visual observations. Quite a few psychological tests were conducted, including ones directed at the development of more accurate and (well-reasoned)

recommendations on the work and rest routines during prolonged flights.

Ye. I. Chazov: Yes, the psychological observations became an important aspect of the medical tests conducted by the doctor-cosmonaut. Being in possession of a certain amount of knowledge in the field of psychology, it may be easier to solve several psychological problems which arise within small groups on prolonged space flights.

O. G. Gazenko: The results of the psychological observations conducted are especially important still, because, for the first time, a crew of three was on a space flight for such a prolonged time. Twice during the flights of visiting expeditions six cosmonauts were working on the station at the same time. This had also been unprecedented. I would like to emphasize that the ground felt constantly that a spirit of mutual understanding, friendly collaboration and genuine comradeship prevailed among the crew over the course of the flight.

[Question] And at the time of the flight and after its completion, specialists, flight supervisors and the cosmonauts themselves emphasized repeatedly that the crew of Mayaki was very harmonious and on friendly terms with one another. Oleg Yuryevich, in your opinion, what became the principal determining factor which enabled the maintenance of such a psychological climate in orbit? It must be confessed that even on the ground, unfortunately, it is not always possible to constantly maintain genuinely comradely relations in the collective. And yet, there in space the cosmonauts had been cut off for a long time from their usual ground conditions, from relatives and friends...

O. Yu. Atkov: I think this is the result of the good working harmony established during the flight training period, of the well-intentioned , business-like relations with the Flight Control Center [FCC], of the proper distributions of responsibilities in the course of the flight and of the implementation by the ground of a set of measures for psychological support (we were "visited" by our families and friends, by writers and journalists, and by artists and atheletes). This enabled us to keep up with all the earthly affairs and not be cut off from the ground. And this is a very important psychological aspect. Of great significance were the meetings with FCC specialists, with the developers of the experiments and with the developers of the on-board equipment. There in space it is very important to know that your work has some use, that the well-intentioned observations and the practical suggestions which result from it are satisfactory and important, in brief, that it is very important to have a professional-like dialog with the ground. This makes it possible to properly evalute what has been done and to make any necessary adjustments in the conducting of one test or another.

This much is certain: the mutual understanding of the flight's participants, their close contact with the ground and the high degree of professionalism on the part of each crew member determine to a very decisive degree the psychological climate in the collective and are both required conditions for and guarantees of the success of all the work in space. One needs to understand when it is time to keep quiet and when it is time to say a few words that are needed precisely at a given moment--this is important on the ground, and in space even more so.

[Question] In none of the previously completed space flights was so much work done outside the station, in open space. What was the role of the doctor at the time the cosmonauts were carrying out these operations?

O. G. Gazenko: For the first time in the history of space flights, in the course of one expedition, Cosmonauts Leonid Kizim and Vladimir Solovyev made six excursions into open space, which lasted a total of 22 hours and 50 minutes. Outside the station the cosmonauts performed exceptionally important assembly work on the consolidated propulsion system and fitted two additional solar battery panels. Work outside the confines of the stations entails a large degree of emotional and physical stress. and, therefore, serves as a distinctive functional test for the medical personnel. While remaining inside the station the doctor monitored the functioning of the station's systems and the spacesuits along with the cosmonauts' medical parameters. In addition, he collated their activities with the instructions, gave the commands for carrying out corresponding tests to check hermeticity and maintained contact with their comrades on the ground.

[Question] It is well known that the most important place among the set of measures directed at preventing the unpleasant effects of weightlessness on the human body was given to the athletic exercises. What was the "sports" program of the Mayaki like?

O. Yu. Atkov: In weightlessness, for all practical purposes, there is no strain on the supporting muscle system. In order to move objects, even very heavy ones by ground standards, here, in the "world without weight," practically no effort is required. The muscles are idle and, if appropriate steps are not taken, gradually begin to "waste away." Their size decreases and their tone is reduced and this in turn affects many of the metabolic processes in the body. In order to prevent this and be able to consequently handle the ground gravity satisfactorily, each of us ran approximately 5 kilometers daily on the treadmill and "rode" nearly 10 kilometers on the space bicycle (the veloergometer). In addition exercises were performed using exercisers and various rubber stretch devices. To condition the shoulder area and the arms we regularly used our hands to pedal the veloergometer. To assist in putting strain on the muscle system we almost constantly wore a special suit which had rubber bands sown into its fabric, which created specific stress on the various muscle groups during movement. Before the completion of the flight we carried out conditioning in the CHIBIS vacuum suit (ZEMLYA I VSELENNAYA, 1983, No 5, p 4--Ed.) During this conditioning there is a transfer of blood into the lower half of the body, which is typical for the vascular system under normal ground gravity conditions. Such conditioning sessions aid in maintaining the muscle tone of the large vessels and, to a significant degree, this prevents a reduction in the cosmonauts' orthostatic stability after a flight.

O. G. Gazenko: The problem we are working on solving by introducing conditioning in the "space stadium" is to stress the muscles and to not allow the body's systems to "forget" their ground purposes. The fact is that, no matter how long the space flight, the Earth is waiting for the cosmonauts and a favorable reception depends largely on how you worked out in space.

Physical conditioning sessions, properly set-up work and rest routines, a rationally organized diet, sanitation and hygiene measures and a set of measures for psychological support--all these items enabled the crew to maintain not only a good state of health and a high level of efficiency for the duration of the entire expedition, but also to resume sufficiently quickly and completely a normal ground existence after the flight.

I would like to note that both the participants of previous flights and the Mayaki themselves displayed a great deal of initiative and truly creative wit in improving the on-board system of physical exercising.

Ye. I. Chazov: In the SPORT experiment the cosmonauts used several new exercise routines which permitted a shortening of the time spent on physical exercises by using more intensive stress levels and freeing up time for performing other work. Also used was a new procedure for functional testing and conditioning sessions using the influence of negative pressure on the lower half of the body, during which, for the first time, the amount of negative pressure rose to 45 mm on the mercury column. Such a procedure became possible insofar as the tests and the conditioning sessions were conducted in the presence of a doctor. This permitted a more complete evaluation of the reserve capacities of the cardiovascular system, which is very important for the proper distribution of work loads and for prediction of the cosmonauts' state of health at various stages of the flight, and, in addition, for the carrying out of more effective conditioning sessions before the flight's completion.

[Question] Oleg Yuryevich, two short-term visiting expeditions worked on the station together with your crew. What kind of medical tests and experiments were conducted at this time?

O. Yu. Atkov: When the Soviet-Indian crew of Yuriy Malyshev, Gennadiy Strekalov and the Indian citizen, Rakesh Sharma , was working on board the station, we studied the functional condition of the cardiovascular system during the period of the human body's rapid adaptation to weightlessness in the BALLISTO and VEKTOR experiments. Several possible reasons for the onset of motion sickness during a flight were investigated, as well as changes in the biomechanics of movements and disruptions of coordination in weightlessness.

We continued observing how the period of rapid adaptation to weightlessness affects the human body with the second visiting expedition of Vladimir Dzhanibekov, Svetlana Savitskaya and Igor Volk. Examinations were made of the cardiovascular system at rest and during the performance of physical exercises, as well as during the use of prophylactic equipment--special pneumatic cuffs, which inhibit the circulation of blood to the upper half of the body, which is typical under the conditions of weightlessness. In addition, we studied the influence of space flight on the visual analyzer and on mental efficiency. Experiments in space biotechnology were done on the new, improved TAVRIYA devices, with the goal of obtaining experimental batches of medicinal substances, purified antibiotic preparations and the division of cells for their subsequent use on the ground for medical purposes.

[Question] Yevgeniy Ivanovich, inasmuch as the subject has been broached con-

cerning the use on the ground of the results of space research, would you like to touch in a little more detail on what space medicine today is doing towards solving the numerous problems of "ground" medicine and public health?

Ye. I. Chazov: Whereas, at first, space medicine only took from "ground" medicine, now the process has been reversed. More and more frequently, in clinics and doctors' offices it is possible to run into equipment that was designed for space research. Thus, the LENTA-MT system for monitored recording of an electrocardiogram is being mass-produced today for the needs of applied public health care. The time is not far off when our ambulances will be equipped with the ARGUMENT device, which is very suitable for urgent diagnoses of cardiovascular diseases. The OKSIMTER device, developed for examination of the oxygen supply of body tissues under the conditions of weightlessness, is being used in clinics for the diagnosis of a number of illnesses.

Research in the field of space medicine has enabled the development and introduction into public health care of new criteria and standards of human endurance of functional loads--ones such as the proportioned physical load on the veloergometer, the passive orthostatic and anti-orthostatic tests and the test using negative pressure on the lower half of the body (in our center the vacuum capacity is being used for the diagnosis and treatment of a number of illnesses).

The methods and equipment which permit the recording and transmission of the cosmonauts' various physical parameters to the ground via the telemetry systmes can also be used on the ground--let's say, in order to connect some hospital in a remote region with the nation's leading medical centers via satellite.

[Question] Oleg Georgiyevich, over the past few years in our country a series of lengthy space flights have been successfully completed. The Mayaki worked in orbit of 237 days. What was the main result for space medical personnel which was derived from this longest of all space flights--this "space odyssey?"

O. G. Gazenko: If I may speak briefly, for us, the medical personnel, the main result is that for the entire length of the flight the cosmonauts maintained a good state of health, the necessary level of efficiency and an excellent psychological climate among the crew.

The Mayaki (together with the space medical personnel) entered an area, which, until this flight, had still been terra incognita, having moved further along the cosmic highway for an additional 26 days. This required precision, exactness and reasonableness from the specialists in their conclusions and recommendations. On the whole it is possible to say that the fundamental result of the flight was the increase in the length of man's stay in space to 8 months, which, in comparison to flights of lesser duration, did not lead to the appearance of any kind of qualitatively new changes in the cosmonauts' bodies.

Once again this shows conclusively that the strategy chosen by Soviet specialists of a gradual and sequential increase in the length of a man's stay in space has completely proved its value and enabled an ever more confident

feeling in man of being at home in space.

[Question] Oleg Yuryevich, 20 years separate your flight from the flight aboard the Voskhod craft by Boris Borisovich Yegorov--the first doctor in space. Could you make a comparison between these two space voyages?

O. Yu. Atkov: As it happens, our crew's flight was completed in October, coincidentally exactly 20 years after Boris Borisovich Yegorov, on board the Voskhod craft together with Vladimir Mikhaylovich Komarov and Konstantin Petrovich Feoktistov, became the world's first doctor to go into space. Of course, our flights have differed both in duration and in the volume of conducted experiments and medical research programs. But there is one very important circumstance that, in my opinion, is common to both flights. In both instances, as a result of the doctor's work in space, not only was a lot of important data obtained, but a lot of new questions were posed, the solution of which requires the further study of the very complex human mutual relations in what for man is the still so unusual space medium.

Yuriy Alekseevich Gagarin, the first traveler of the celestial paths, was firmly convinced that "Soviet cosmonauts will always be storming the Universe." It is a pleasure to recognize that even our crew of Mayaki left its mark on the cosmic paths and made a contribution to our common pursuit--the storming of the Universe.

PHOTO CAPTIONS

Photos 1-5 by A. D. Dotsenko, photos 6-7 by A. A. Pushkarev.

1. P. 50. Academicians O. G. Gazenko (on right) and Ye. I Chazov, in the Medical Information Collection and Processing Center of the Biomedical Problems Institute, evaluate the results of the medical examinations and experiments.

2. P. 51. The set of instruments for rendering stomatological first aid.

3. P. 51. "Vektorkardiograf" device for examination of the functional condition of the cardiovascular system.

4. P. 52. "Biokhim" device for quantitative analysis of several electrolytes which define the condition of the basic metabolic processes of a cosmonaut's body.

5. P. 52. "Plazma" device for separating blood taken from a cosmonaut into its regular elements and plasma and for preserving the samples for subsequent biochemical analysis on the ground (on the right is the refrigeration unit for preservation and on the left is centrifuge for separation of the blood.

6. P. 54. The pre-flight conditioning of the crew under the conditions of weightlessness in water (the working out of the operations connected with the excursions into open space).

7. P. 54. Pre-flight examination: working with the "Chibis" suit, which creates negative pressure on the lower half of a cosmonaut's body.

Fig. 1

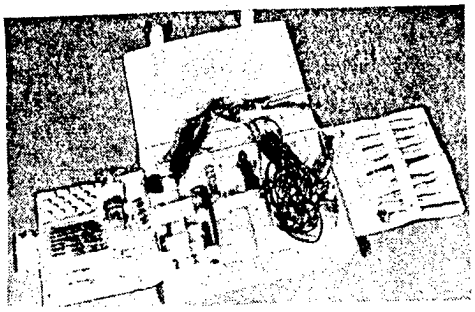

Fig. 2

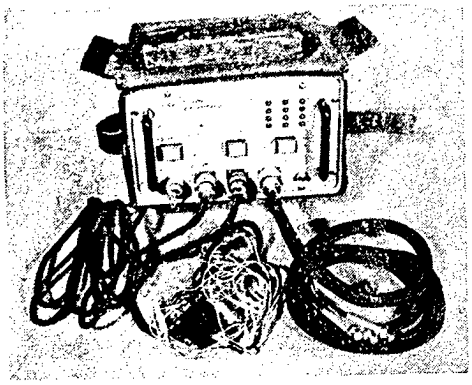

Fig. 3

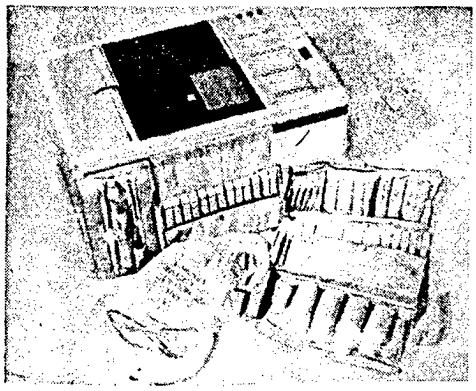

Fig. 4

Fig. 5

Fig. 6

Fig. 7

12752
CSO: 1866/43

UDC 581.845+620.187/:582.31/.9

ULTRASTRUCTURAL AND SOME PHYSIOLOGICAL FEATURES OF PHOTOSYNTHETIC APPARATUS OF GARDEN PEA CULTIVATED FOR 29 DAYS IN SALYUT-7 SPACE STATION

Baku IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: SERIYA BIOLOGICHESKIKH NAUK in Russian No 6, Nov-Dec 85 (signed to press 12 Feb 86) pp 18-23

[Article by A.A. Aliyev, Z.K. Abilov, A.L. Mashinskiy, R.A. Ganiyeva, G.K. Ragimova and U.K. Alekperov, AzSSR Academy of Sciences Institute of Botany]

[Abstract] Pisum Sativum was grown in the Salyut-7 space station for 29 days under the Oazis-1 MA program in order to study the problem of growth regulation, development and generative cycle of vegetative systems; the resolution of such problems will allow the creation of a self-controlled living space within the closed environment of a spacecraft, needed for normal human vital activities during long-term space flight. The SF-26 and SF-14 spectrophotometers were used to determine chlorophyll "a" and "b" content in the test samples and controls grown on the ground under the same conditions. A comparison of the ultrastructure of the palisade parenchyma of the mesophyll of pea leaves from different layers of 29-day sprouts revealed significant morphological changes in the structural organization of the chloroplasts of the test samples. The greatest changes occurred in the grana-thylacoid membrane system of the chloroplasts. Chlorophyll synthesis was stimulated and shift occurred in the low temperature (liquid nitrogen) fluorescence peak, apparently due to the increase in the percentage of long wave aggregated forms. The average ratio of chlorophyll increase in the test samples over the controls was $Chl(a + b)/Chl(a - b) = 1.67 \pm 0.2$. Figures 2; references 11: 7 Russian, 4 Western.
[96-8225]

UDC 531.55:521.1

NUMBER OF IMPULSES IN MINIMUM-FUEL FLIGHT BETWEEN CLOSE KEPLERIAN ORBITS

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA: MATEMATIKA, MEKHANIKA, ASTRONOMIYA in Russian No 1, Jan 86 (manuscript received 12 Oct 84) pp 103-112

[Article by S.N. Kirpichnikov and V.F. Baykov, Leningrad University]

[Abstract] Methods for synthesis of optimum control were employed, in conjunction with the Pontryagin maximum principle, in a determination of the maximum number of impulses in minimum fuel flights between stipulated near-Keplerian elliptical orbits. Flight maneuvers were assumed to be of the impulse type and their characteristic velocity was minimized. Unlike the similar interorbital transfer problem, involving construction of a transfer orbit from an initial to a final orbit, in the case of interorbital flight considered here it is necessary to construct a flight trajectory beginning at the initial orbit which only intersects the final orbit. Solution of this problem requires synthesis of optimum control within the framework of the optimization problem with a mobile right end. Eccentricity e of close limiting Keplerian orbits is an important parameter governing the sought-for maximum number of impulses. V.A. Antonov, et al. (MEKHANIKA UPRAVLYAHEMOGO DVIZHENIYA I PROBLEMY KOSMICHESKOY DINAMIKI, Leningrad, pp 165-168, 1972) studied a similar problem of the maximum number of impulses in a minimum-fuel transfer between close Keplerian orbits and demonstrated that in a coplanar case with $e > 0.925$ and in a general noncoplanar case with any non-zero eccentricity the optimum transfers would be three-impulse. Other studies of the same problem in a coplanar formulation revealed that only one-impulse flights would be optimum. This new study differs in that the complanarity assumption is eliminated. The principal result of this study was that in the general case considered a three-impulse flight would not be optimum. Figures 3; references 7: 5 Russian, 2 Western.

5303/8309
CSO: 1866/89

UDC 629.7.015

CONTROL OF SPACE VEHICLE ENTERING INTO SATELLITE SYSTEM USING ELECTROJET ENGINES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 5, Sep-Oct 85 (manuscript received 12 Dec 83) pp 691-700

[Article by Yu. P. Rylov]

[Abstract] Electrojet engines are one of the most promising types of low-thrust engines for control of motion of space vehicle systems. A study was made of the fundamental characteristics of flight of space vehicles with electrojet engines and optimum algorithms were formulated for their flight control. The attainability of the required flight accuracies was evaluated and an analysis of the use of electrojet engines on satellites of the "Meteor" series was made. Maneuvers for correction of space vehicle flight and guidance are executed on several revolutions (in contrast to use of chemical engines, with maneuvers executed by several engine firings at optimum points in orbit). The establishment of any system of special-purpose satellites requires the placement of each satellite at a stipulated working point in space, with successive consistent flight control of each individual space vehicle, a task most effectively performed by electrojet engines, as is demonstrated in the presented materials. The "coefficients of thrust impulse loss" are introduced as a test of efficiency of electrojet engine use. These are based on approximate analytical methods for solving problems of flight in near-circular orbits. Algorithms were developed for control of "Meteor" satellites. These were actually employed with the electrojet engines on the "Meteor-10," "Meteor-18" and "Meteor-Priroda" and it was demonstrated that the required control accuracy was achieved. Figures 4; references 14: 13 Russian, 1 Western.

5303/8309
CSO: 1866/28

UDC 629.783.064:519.863

UNIVERSALIZATION OF PARAMETERS OF ELECTROJET CORRECTING ENGINE FOR ARTIFICIAL EARTH SATELLITE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 5, Sep-Oct 85 (manuscript received 12 Jul 83) pp 701-712

[Article by M.A. Kuzmin]

[Abstract] Electrojet engines powered by current from solar cells have excellent characteristics for use in correcting the orbital parameters of artificial earth satellites. When solar cells are used as the power source it must be taken into account that the correcting engine must compensate the drag acting upon both the satellite skin and on the panel of solar cells. With this factor taken into account, a method is proposed for determining the optimum engineering design parameters for such an engine, making use of a test for the minimum of the flight mass of the system with a deterministic stipulation of the initial data. After examining the desirable parameters of single-purpose correcting engines intended for solving a single problem, attention is directed to the economic necessity for the designing of multipurpose engines satisfactory in solving some set of problems. Possible formulations of the problem of universalization of engine parameters and different approaches to its solution (statistical, game theory) were outlined by G.L. Grodzovskiy, et al. in MEKHANIKA KOSMICHESKOGO POLETA. PROBLEMY OPTIMIZATSII, Moscow, Nauka, 1975; these are applied in solving the problem of universalization of parameters for a multipurpose correcting engine. Four combined quality indices for a universal system are proposed and examined in detail. Figures 3; references: 4 Russian.

5303/8309
CSO: 1866/28

UDC 536.24:629.78

TEMPERATURE REGIME OF INHOMOGENEOUS ELEMENTS IN SPACE VEHICLES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 5, Sep-Oct 85 (manuscript received 25 Jul 83) pp 719-728

[Article by V.S. Novikov]

[Abstract] A simple and effective method for obtaining an analytical description of some aspects of heat exchange of inhomogeneous components of space vehicles is proposed. The following cases are examined: periodic radiative-convective heat exchange of a single-layer spherical skin; radiative-convective heat exchange of a two-layer spherical skin; radiative-convective heat exchange of limited two-layer cylindrical skins; radiative-convective heat exchange of limited two-layer plate. In the examination of these variants the ambient temperatures are regarded as both constant and dependent on spatial coordinates and time. The objective of the proposed method is to simplify the complex and unwieldy solutions of such problems given in the fundamental treatise on computations of space vehicle heat exchange (V.M. Zaletayev, et al., RASCHET TEPLOOBMENA KOSMICHESKOGO APPARATA, Moscow, Mashinostroyeniye, 1979). Much of the method presented represents a generalization, integration or refinement of earlier work by the author (ENERGETIKA I TRANSPORT, No 4, p 134, 1982; FIZ. I KHIM. OBRAB. MATER., No 1, p 27, 1983). References: 8 Russian.

5303/8309
CSO: 1866/28

UDC 629.7.015.3

INERTIAL NAVIGATION ALGORITHMS FOR SPACECRAFT WITH HIGH LIFT-DRAG RATIO DURING DESCENT IN ATMOSPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 6, Nov-Dec 85 (manuscript received 5 Apr 82) pp 843-848

[Article by V.L. Balakin and Yu. N. Lazarev]

[Abstract] An electronic computer was used in modeling the motion of a spacecraft with a high lift-drag ratio during descent in the earth's atmosphere for studying the possibilities of an algorithm for inertial navigation and evaluating the limits of its applicability. A piecewise-linear banking angle program was selected as the nominal control program (this program ensures motion of a spacecraft without ricochets for nominal initial conditions of entry into the atmosphere and a nominal lift-drag ratio value. A quasistationarity of the evaluated parameters in a large part of the descent trajectory was assumed. The results of computations show that in contrast to the corresponding algorithm proposed by D. Ye. Okhotsimskiy, et al. (ALGORITMY UPRAVLENIYA KOSMICHESKIM APPARATOM PRI VKHODE V ATMOSFERU, Moscow, Nauka, 1975) this navigation algorithm makes possible more precise determination of phase coordinate values for a quite broad range of closure times. In comparison with an inertial navigation algorithm in an open state, the closed algorithm ensures better determination of altitude in the range of closure times from 320 to 480 s. Another algorithm, based on partial separation of the problems of evaluating state and parameters ensures better determination of altitude in the range of closure times from 270 s to the end of applicability of the algorithm. The proposed inertial navigation algorithms, with refinement of the phase coordinates and determination of lift-drag ratio, can be used with quasistationary angles of deviation of the gyroplatform from the stipulated position up to 1°. Application of these inertial navigation algorithms makes it possible to decrease the final miss by several tens of kilometers and thereby substantially increases the accuracy of space vehicle control. Figures 6; references: 2 Russian.

5303/8309
CSO: 1866/53

UDC 531.391

EVOLUTION OF ROTATIONS OF SYMMETRIC SATELLITE WITH VISCOELASTIC RODS ABOUT CENTER OF MASS IN CIRCULAR ORBIT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 6, Nov-Dec 85 (manuscript received 7 Aug 85) pp 863-868

[Article by V.G. Vilke, V.G. Demin and Yu. G. Markov]

[Abstract] A study was made of the motion of a symmetric satellite about its center of mass, in the equatorial plane of whose ellipsoid of inertia there are four uniform viscoelastic rods. The center of mass of the system is assumed to move in a circular orbit in a central Newtonian force field. The flexural deformations of the rods, accompanied by the dissipation of energy, result in the evolution of rotational motion of the system. Approximate equations describing this evolution were derived earlier by V.G. Vilke ("Separation of Movements and Averaging Method in Mechanics of Systems With an Infinite Number of Degrees of Freedom," VESTN. MGU, SER 1. MATEMATIKA, MEKHANIKA, No 5, pp 54-59, 1983). The problem is formulated as follows. The center of mass C of the system describes a circular Keplerian orbit relative to the attracting center O; the flexural oscillations of the rods exert no influence on its motion. A coordinate system $C\,\xi_1\xi_2\xi_3$ is introduced which moves translationally, with the $C\xi_3$ axis orthogonal to the orbital plane. The radius vector of the attracting center in this coordinate system has a projection $R\cos\omega_0 t$, $R\sin\omega_0 t$, 0), where ω_0 is orbital angular velocity. Such a formulation provided a basis for describing the evolution of rotational motion of the particular system. References: 4 Russian.

5303/8309
CSO: 1866/53

UDC 629.78.03.001.24

OPTIMIZATION OF SPACECRAFT ELECTRICAL SUPPLY AND THERMOSTATING SYSTEM

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 6, Nov-Dec 85
(manuscript received 19 Sep 83) pp 869-875

[Article by M.M. Grishutin and V.N. Rogov]

[Abstract] An energy supply and active thermostating system (ESATS) for a spacecraft is proposed. It is designed for producing electrical energy and active thermostating of a supply of cryogenic fluid (oxygen) over a long period of time. The principal assemblies of such an ESATS would include a gas-turbine converter (GTC) whose working medium would be helium, a helium turbo gas-expansion cooling apparatus (TGECA) and a tank of a particular geometry and size supplied with shielding-vacuum insulation. The electric energy produced by the GTC is supplied to spacecraft users and is partially used in driving the compressor of the TGECA, whose refrigerator is placed in a cryostated tank and receives the heat entering the latter from the outside. The proposed system was investigated for the purpose of optimization of the ESATS with respect to the minimum weight of its three principal assemblies. The mathematical modeling approach was selected for this study. The required expressions were derived for relating the mass of the system and the thermodynamic and discharge parameters of the GTC and TGECA and the design parameters of the tank. An analysis was made of the external conditions of functioning and linking of the ESATS and other spacecraft systems. The parameters to be optimized were selected and the admissible values of the independent variables were determined. An expression for determining the final mass of the ESATS was derived. The optimization problem was found to be a problem in nonlinear programming. Figures 4; references: 6 Russian.

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CSO: 1866/53

UDC 629.197.2

SPEED-OPTIMUM ARTIFICIAL EARTH SATELLITE TRANSFER INTO QUASICIRCULAR ORBIT FOR CASE OF LOW TRANSVERSAL THRUST

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 6, Nov-Dec 85 (manuscript received 21 Feb 84) pp 933-937

[Article by V.A. Okhorzin]

[Abstract] A special case of speed-optimum (most effective) satellite transfer into a quasicircular orbit was investigated. Closeness of the initial and final orbits to circular was assumed, making it possible to linearize the equations of motion relative to a "reference" circular orbit. Then it was possible to use such a linearized system to obtain a solution of the problem by the moments method. This requires solution of the problem of minimizing of a function of three variables, providing a reliable solution from any initial approximation. This solution was then used with the iterations method for finding a quasioptimum solution in the initial nonlinear system. The solution has a second-order error in speed relative to the thrust value, but with any desired degree of accuracy satisfies the stipulated boundary conditions for the equation of motion. After complete formulation of the problem, a solution was found in a linear approximation. An expression was found for optimum control for a problem with fixed time, as well as an expression for the total time of engine operation required for the desired transfer. This lays the basis for writing of a final algorithm for optimum transfer. A specific example of computations is given. Figures 1, references: 3 Russian.

5303/8309
CSO: 1866/53

'COSMOS-1500' DATA SYSTEMS

Moscow VODNYY TRANSPORT in Russian 29 Mar 86 p 1

[Article by I. Ivanov (Moscow)]

[Abstract] The article reports on results of studies of Earth from space with the aid of the experimental oceanographic satellite "Cosmos-1500," which was launched more than 2 years ago, and on the use of this satellite in support of shipping in the polar regions.

Data on the world's oceans and the atmosphere are gathered by the unique instrumentation of this satellite and transmitted to the State Scientific Research Center for the Study of Natural Resources in Moscow, where the data are recorded twice a day by special monitors in the center's data-processing department. Yuriy Glebovich Spiridonov, head of a laboratory at the center, related that instruments on "Cosmos-1500" have enabled the laboratory to conduct regular global scanning of Earth at any time of the day and in any kind of weather.

The satellite's instrumentation is said to include a side-looking radar system, which is being tested together with a new system for scanning in the optical-frequency range. The optical system includes a special multichannel scanning device with low resolution. The images obtained by the two systems form a single, combined picture on board the satellite. This picture can be transmitted to Earth while the satellite is directly over an area of interest, or it can be stored temporarily in the satellite's onboard memory and transmitted when "Cosmos-1500" is over regional receiving centers located in Moscow, Novosibirsk and Khabarovsk. Pictures can also be transmitted to receiving sets on board ships and at polar outposts.

Mention is made of plans for launching several similar satellites, which will make it possible to study oceans, land surface and the atmosphere everywhere on Earth.

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CSO: 1866/139

SPACE APPLICATIONS

SATELLITE COMMUNICATIONS CENTER UNDER CONSTRUCTION AT NAKHODKA

Moscow TRUD in Russian 25 Apr 86 p 4

[Article by V. Chetvergov (Nakhodka, Primorskiy Kray)]

[Excerpt] In the city of Nakhodka, testing of an International Satellite Communications Center is under way. This is the second station of its kind to be built in our country, and it is the first in the Far East.

The station's antennas are pointed with precision to the place where, 36,000 kilometers up in the sky, three relay satellites are suspended in permanent orbit.

I entered the center's building. Here there are rooms that are sealed off from the outside environment, and where constant temperature and humidity are maintained. This is essential for the trouble-free operation of super-sensitive receiving and transmitting apparatus. The station's chief engineer, V. Vorob'yev, escorted me on a tour of the instrumentation.

"There is a good reason for calling this station an international one," Valeriy Yur'yevich explained. "More than 40 countries of the world which belong to the 'INMARSAT' International Communications System are interested in seeing the station's testing completed as soon as possible."

There are already about 15 such stations in the world. Two of them have been built in our country. The first one is operating in Odessa. It is supporting reliable telephone, telex and telegraph communications between ships located at any points in the Atlantic. When the testing of the station in Nakhodka is completed, 'silent spots' in the expanses of the Indian and Pacific oceans will disappear.

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COMMENTS ON 'INTERCOSMOS' STUDY 'BLACK SEA-85'

Moscow OGONEK in Russian No 49, 30 Nov-7 Dec 85 pp 17-18

[Article by Vladimir Kovalev, special Ogonek correspondent, "First Aid for the Black Sea: 'Intercosmos' Countries Are Creating a New Generation of Oceanographic Satellites," Sevastopol, Varna, Moscow; capitalized passages printed in boldface]

[Text] At a Dangerous Pass

On its twelfth voyage, the Professor Kolesnikov, a research vessel of the Marine Hydrophysical Institute of the UkSSR Academy of Sciences, left Sevastopol, its port of registry, for the sake of saving the riches of the Black Sea. Ahead were 3,000 miles and a month of strenuous work. Aboard the vessel were chemists and mathematicians, hydrologists and optics specialists, biologists and hydrophysicists. Ogonek correspondents were registered as passengers in the ship's list, but in fact were subject to the daily routine of the scientific expedition taking part in the "Black Sea-85" joint experiment. It is being conducted in accordance with the "Intercosmos" program of international cooperation on research and peaceful use of outer space.

"By the beginning of the fourth decade of the space age, artificial Earth satellites will be on round-the-clock watch, for it is high time to pay back mankind's debts to the sea and ocean. Together with cosmonauts in orbit, we are actually taking part in creating a new generation of oceanographic satellites which are to work with total efficiency and solve specific national economic problems of CEMA member countries," says Vyacheslav Urdenko, chief of the joint international expedition, summarizing the essence of the experiment.

"Now, about these debts. Very interesting data were given to me by the Marine Hydrophysical Institute, the Institute for the Biology of Southern Seas of the UkSSR Academy of Sciences, and later by the Varna Institute for Marine Research and Oceanology of the Bulgarian Academy of Sciences. It seems that the Mediterranean Sea, which not long ago was the richest in flora and fauna, has lost 40 percent of all its living creatures in the past two decades. Irrevocably lost! The world's ocean, which has been converted into the world's dumping ground, is no longer capable of performing tasks such as recycling millions of tons of garbage while remaining relatively clean. If it is further

covered with petroleum film (and more oil is now entering the water than man obtained in the early days of petroleum extraction), the planet risks being left without oxygen. The entire huge Black Sea has only nine (!) different types of seals left; at one time seals flourished in abundance. There are not very many dolphins either--these beauties of the sea are perishing, swallowing plastic packages, bottles..."

"The Black Sea is a nearly closed water basin connected to the 'outside world' by a single narrow channel," said the deputy director of the Varna Institute, Petko Dimitrov. "The word 'nearly' conceals the trillions of cubic meters of dirty salt water in the Mediterranean Sea that pour through the Bosporus from the South. Our sea still managed to withstand the massive invasion of tourists, tolerates plants and combines on its shores, fills fishing trawlers, even if it is with anchovies, and serves as a fairly good transport route. However, slowly but surely, it is coming to a sad state. We are beginning to look apprehensively at the Danube, which collects water from 14 European countries and carries the murky liquid to the western part of the Black Sea.

UNDER THESE CONDITIONS, ANY SCIENTIFIC RESEARCH BECOMES CRITICAL. A COMMON PROBLEM HAS ARISEN SIMULTANEOUSLY IN SEVERAL EUROPEAN STATES: THE BLACK SEA AS PART OF THE WORLD OCEAN'S GLOBAL ECOLOGY. SOCIALIST COUNTRIES--CEMA MEMBERS--ARE SETTING AN EXAMPLE OF GOAL-ORIENTED, JOINT COOPERATION, HAVING UNITED THEIR SCIENTIFIC AND INDUSTRIAL CAPABILITIES IN A PURPOSEFUL PROGRAM, "BLACK SEA"-"INTERCOSMOS." SPACE SCIENCE HAS BEEN GIVEN A KEY ROLE IN THIS PROGRAM, WHICH IS SCHEDULED TO LAST AT LEAST A DECADE. SYSTEMS IN NEAR-EARTH ORBIT WHICH ARE CAPABLE AT ANY MOMENT, DAY OR NIGHT, OF "LOOKING" THROUGH THE CLOUDS, "SCANNING" THE SEA, AND THEN IMMEDIATELY TRANSMITTING THIS DATA TO EARTH MUST BE CREATED.

As early as February 1979, the first Soviet oceanographic satellite, Cosmos-1076, began functioning in orbit. Shortly thereafter, instruments on Intercosmos-20 and Intercosmos-21 satellites were aimed at the oceans and seas.

These were only the first logical steps.

The Riddles of Weather

By evening of the next day, the Professor Kolesnikov had sailed out of the port of Varna. First thing in the morning they began to meet old acquaintances--specialists of the GDR Academy of Sciences Institute for Space Research. Friends and colleagues--expedition director Vyacheslav Urdenko and Dr Gerhard Zimmerman--exchanged hearty handshakes. The appearance of Klaus Bachmann aroused a storm of emotion, and they reminisced about a joint trip to the Atlantic several years back, this strong, stockily built man's battle with seasickness, and his attempts to memorize certain intricate Russian words. Klaus, an electronics engineer, now introduced the new expedition members, Heinz Hendel and Thomas Waltzell.

By noon, everyone else--young engineer-physicists from Gdansk University Ludwig Targonski and Adam Krenzhel and the serious, quiet Georgiy Kamenov from the Central Space Research Laboratory in Sofiya (the only Bulgarian representative, by the way)--had gotten up. That evening in the wardroom, all participants in the international expedition got to know each other. And along side at the quay gleamed the lights of the beautiful Akademik, the Bulgarians' scientific vessel. For them, the "Black Sea-85" experiment was to be a test of their own strengths and capabilities. Far from shore, the two crews had to work side by side. A curious detail: our Professor Kolesnikov was built in Bulgaria, while the Akademik was built at Soviet wharves.

The triangular blue-and-white scientific pennant next to the crimson banner on the mast flaps in the September wind on the open sea. We lie to.

The expedition chief tries to conceal a satisfied smile in his salt-sprayed, sunburned whiskers: everything seems to be going according to the schedule prepared according to the desires of associates from fraternal countries--the GDR, the People's Republic of Bulgaria, and the Polish People's Republic. The Professor Kolesnikov's last four trips were space-oriented, i.e., work was done together with airborne laboratories, and then data were compared with data from Meteor- and Cosmos-series artificial Earth satellites. Vyacheslav Urdenko, a specialist in remote sensing of the sea and atmosphere, candidate of sciences, is the first and only director of Black Sea voyages under the "Intercosmos" Program. He was born far away in the Far East, finished graduate school in Leningrad, and has 15 years expeditionary experience. His wife is a marine biologist and also often goes on research voyages. Their ships sometimes meet on the open sea....

"To the uninitiated it seems as if hydrophysics consists of endless formulas, graphs, differential equations," my interlocutor strays from the facts of his biography. "Well, in a way that's true. It's no problem for a specialist to determine the condition of the sea or a part of it with those tools. The measurements we take and the formulas and equations we derive make it possible to come closer to solving the riddles of weather or climate. I repeat, only specialists can make sense of this gigantic flow of information. If we assign information collection to automated devices in orbit, then on Earth we have to use computers to decode, compare, and analyze data, and write it for display in normal human language--that's the thing!"

"Aren't hydrophysicists trying to take away meteorologists' bread and butter?" I jokingly ask the scientist.

"On the contrary. We want to help them. If my memory serves me correctly, the Swedes gave their national weather bureau a literary prize for science fiction last year. In the future, long-term seasonal predictions will be prepared entirely by a computer which has access to data from oceanographic satellites. Then, possibly, fewer ships will run into hurricanes and sink. Ultimately, is it really so hard to tell whether the ocean is clean? Unique

instruments for "inspecting" the sea from on high, i.e., for remote sensing are being created in laboratories of the USSR, the GDR Academy of Sciences Institute for Space Research, and other countries of the "Intercosmos" Council. Prototypes for these instruments are usually tested at the Black Sea Scientific Proving Ground. This time they are on the Salyut-7 orbital station and on special airborne laboratories. The action in the "Black Sea-85" experiment is running high in the western part of the sea, replicating in miniature the entire world ocean."

"More than one generation of scientists has studied the sea's secrets. How are we to deal with them now?"

"THERE ARE AS MANY SECRETS IN THE BLACK SEA AS THERE ARE IN ANY OTHER REGION OF THE OCEAN, BUT, GENERALLY, MANY SECRETS LONG AGO CEASED TO BE SECRETS. SCIENTISTS OF THE USSR ACADEMY OF SCIENCES' INSTITUTE FOR THE BIOLOGY OF SOUTHERN SEAS ARE STUDYING HOW TO RAISE MUSSELS AND OYSTERS UNDER NATURAL CONDITIONS AT THEIR EXPERIMENTAL FARMS NEAR SUDAK IN THE BAY OF LASPI NEAR SEVASTOPOL. IF BIOLOGISTS ARE TO ENTER THE EXPANSES OF THE BLACK SEA--AS THE FOOD PROGRAM STIPULATES--THEY NEED A PRECISE MODEL OF IT, INCLUDING ALL CURRENTS AND EDDIES, TEMPERATURES, DEPTHS, AND OTHER PROPERTIES OF ITS WATER. AND WE HYDROPHYSICISTS ARE READY TO OFFER THEM SUCH A GIFT. A MATHEMATICAL MODEL OF THE ECOLOGICAL SYSTEM OF THE NORTHEASTERN PART OF THE BLACK SEA, INCLUDING ANNUAL TEMPERATURE CHANGES, IS ALMOST READY.

Space Works at Sea

"It was several years ago. The Salyut orbital station was flying over the ocean. An unusual sight attracted the cosmonauts. They saw an incredible picture through the portholes: rivers flowing in the ocean, dividing into hundreds of branches; eddies, dark deltas, and mottled currents were clearly visible.... They began photographing without delay, and when they showed the photos to oceanologists on Earth, they literally gasped."

THE PROCEDURE FOR OBTAINING SUCH PHOTOS HAS NOW BEEN DEVELOPED, AND SCIENTISTS ARE PUSHING FORWARD. THE GDR ACADEMY OF SCIENCES' INSTITUTE FOR SPACE RESEARCH, TOGETHER WITH ITS SOVIET COUNTERPARTS, HAS DEVELOPED A UNIVERSAL SPECTROMETER, THE MKS-M, CAPABLE OF SATURAGING AN ORDINARY PHOTOGRAPH WITH A MASS OF USEFUL INFORMATION. BUT IS IT RELIABLE? THIS REQUIRED THAT MEASUREMENTS TAKEN FROM ORBIT BE RECHECKED ON A SHIP, EACH PARAMETER INDIVIDUALLY. IF A HYPOTHETICAL NET WITH MESH SEVERAL TENS OF KILOMETERS WIDE IS CAST ONTO THE BLACK SEA, THEN PROFESSOR KOLESNIKOV VISITS ALL FOUR CORNERS OF THE MESH. THEY ARE CALLED STATIONS. AT THE STATIONS, BATHOMETERS ARE SUBMERGED TO TAKE WATER SAMPLES, DETERMINE ITS TRANSPARENCY TEMPERATURE, SALINITY, CHEMICAL COMPOSITION....

Each morning above the ship an airplane, crammed with electronics, with the number 30030 spirals higher and higher. Even higher, in the blackness of space, the Salyut-7 orbiting scientific station trains its "eyes" on the sea. The airplane's and station's crews are competent participants in the "Black Sea-85" Interprogram.

"Attention, scientific units! All personnel prepare to work with the orbital station!" the command resounds through the ship's communications. After the next correction to the Salyut-7's orbital route, it passes over the Black Sea, and the "Intercosmos" satellite experiment enters the decisive phase."

"The station is above us. The airplane is on the tack."

"On course. Altitude--400."

"Zero reading."

Peaceful space toils for the good of a peaceful sky. There is a businesslike unity of science and industry. The foundations for an intergovernmental ecological monitoring system are being laid.

"It's a shame that the orbital station can't fly over the Baltic Sea," say Polish scientists Adam Krenzhel and Ludwig Targonski. "We couldn't swim in the Gdansk Gulf this summer. It's too polluted. Currents from the open sea are washing up a mass of garbage.... Problems in the Baltic are more complicated than those in the Black Sea. Therefore, we decided to do our basic practice on the "Intercosmos" expedition, which our Soviet colleagues organized. And we're glad that there are representatives of another Baltic government--the German Democratic Republic--along with us in "Black Sea-85."

Four men from Berlin's Institute for Space Research of the GDR Academy of Sciences have occupied the entire upper deck. With the help of members from the team, they dragged up boxes of imposing size, removing dozens of measuring devices from them. Every day early in the morning, puffing on his pipe in a businesslike manner, Gerhard Zimmerman, head of the German group, came on deck. The sun had barely risen above the horizon when they began, figuratively speaking, "chasing" sunbeams. The goal was to keep a sunbeam or its reflection from entering the very complicated electronic device, so that it wouldn't hinder determination of the transparency of the Earth's atmosphere precisely at the moment when the orbital station, the An-30 flying laboratory, and the Professor Kolesnikov are aligned in "vertical linkup."

"We've awaited the launch of the Soyuz T-14 with particular impatience," says Gerhard Zimmerman. "The arrival of a visiting expedition at the Salyut-7 means a working check of the MKS-M spectrometer, which we've probably already told you about. It makes it possible to take soundings in the sea over a very wide range of electromagnetic waves. We hope that the cosmonauts will not have to watch over the instrument as if it were a little child. We tried to make it compact and adequately self-sufficient."

By this point in the history of the "Intercosmos" Council, the "Black Sea-85" experiment has become an important phase in organization of large international expeditions. Time will tell whether the giologists' sea model will be detailed further, but there is no doubt that a wealth of data for long-term meteorological prediction has poured in. Preliminary results of all four Black Sea expeditions

will be summarized next year in Tallinn, where a major meeting on organizing Socialist countries for peaceful space research will be held. Step by step, the day and hour are approaching when space complexes for immediate tracking of the status and evolution of marine ecological systems will be deployed. First in the Black Sea, then, on the basis of experience gained, in the Baltic. With the combined efforts of many governments, it is possible, even in this millenium, to restore the condition first of the seas, then of the oceans....

12809/8309
CSO: 1866/59

UDC 551.465:629.78

SOME CHARACTERISTICS OF SMALL-SCALE OCEAN EDDIES (BASED ON DATA FROM ANALYSIS OF SATELLITE IMAGES)

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 86 (manuscript received 25 Jan 85) pp 14-19

[Article by A.S. Kazmin and N.P. Kuzmina, Institute of Oceanology imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] Small-scale eddies (5-30 km in diameter) were studied by an analysis of videoimages of sectors of the Gulf Stream and North Atlantic Current. Photographs from the "Salyut" orbital station and the ERTS-1 satellite were used. Possible reasons for generation of these eddies are suggested. A photograph from the "Salyut-6" covered a sector of the North Atlantic measuring 180 x 180 km to the southeast of Newfoundland. The photograph revealed a number of facts concerning eddies of this scale not reported earlier. Such eddies can be observed not only in the neighborhood of the main fronts of large-scale currents, but also in the central parts of the flow. It is best to use images in the visible part of the spectrum because it is possible to register eddy formations in absence of surface temperature gradients, which is impossible when using IR images. The eddies may be cyclonic or anticyclonic. Groups of eddies of a still smaller scale exist on the periphery and in the inner part of these small-scale eddies. Small-scale eddies can be formed on the periphery of large-scale eddies and meanders where there are conditions for additional intensification of velocity shear and the generation of instability. There is also a possibility of the formation of small-scale eddies in the inner part of Gulf Stream rings. Figures 4; references 12: 5 Russian, 7 Western.

5303/8309
CSO: 1866/93

UDC 551.465:629.78

REMOTE AND MODEL RESEARCH ON DYNAMICS OF WESTERN PART OF BLACK SEA

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 86 (manuscript received 8 Feb 85) pp 26-31

[Article by E.V. Stanev, L.I. Milenova, V.M. Rusenov and Ye. K. Rumenina, National Committee on Space Research and Use, Sofia]

[Abstract] Satellite images of the western Black Sea make possible a joint analysis of remote and model studies, providing data on the structure of currents along the Bulgarian Black Sea coast. The study was based on multizonal images of Eastern Bulgaria and the Black Sea obtained from the "Salyut-Soyuz" orbital complex on 3 October 1975 with a multizonal camera with a focal length 200 mm in the spectral ranges 510-600, 600-700 and 700-850 nm from an altitude of 230 km and with a spatial resolution of about 20 m. Data obtained with the "Bolgariya-1300-II" apparatus carried aboard the "Meteor-Priroda" satellite were also used. This information included scanner images in the spectral ranges 500-700 and 700-1,000 nm with a resolution of 250 m. There was good agreement between model and remote results, with agreement increasing with a decrease in the scale of the phenomena. The principal feature of dynamics of waters in the coastal zone is an eddy structure of the fields and the meandering of coastal jets. The three-layer structure of currents in the neighborhood of the Bulgarian coast is clearly expressed in both model and remote data. Remote data make it possible to trace the spreading of Danube waters in the western Black Sea and the position of frontal zones. The results are useful in research on the processes of formation and exchange of waters in the Black Sea and also for determining the propagation of impurities in the coastal zone. This is possible only when regular satellite information is available. Figures 6; references 18: 16 Russian, 2 Western.

5303/8309
CSO: 1866/93

UDC 55:629.78

SOME ASPECTS OF GEOLOGICAL USE OF SPACE INFORMATION

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 86 (manuscript received 1 Aug 85) pp 32-42

[Article by V.G. Trifonov and S.S. Shults (Jr.), Geology Institute, USSR Academy of Sciences, Moscow; All-Union Geology Institute, Leningrad]

[Abstract] The geological information yield of spectral and geometrical signatures is determined and compared in order to formulate the most effective strategy for use of space information. Both laboratory and field measurements of the spectral characteristics in the atmospheric transmission windows in the visible and IR regions have demonstrated that most common rock-forming minerals can be identified by registry from space vehicles, but the use of spectral characteristics for mapping rocks involves many difficulties. A comparison of different approaches made clear that the specifics of geological features are such that they can be characterized more fully by using geometrical rather than spectral signatures. This applies, in particular, to tectonic features and phenomena. Even in the study of the mineralogical composition of rocks, when spectral signatures are most informative, geomatrical signatures can also be used due to tectonic control of geological bodies of different composition or their expression in the landscape. Use of geometrical signatures is facilitated by the fact that they have been used by geologists for many years in the interpretation of aerial photographs. However, the use of geometrical signatures has not been perfected. Geometrical keys must be formulated and an atlas of standard images prepared. Availability of such an atlas would aid in the formalization and automation of the interpretation of geological formations on the basis of their geometrical signatures. A combination of spectrometric data and full analysis of the geometry of natural bodies will ensure the most complete aerospace study of geological formations. Figures 5; references 15: 12 Russian, 3 Western.

5303/8309
CSO: 1866/93

UDC 528.77:550.814+629.78(571.1)

INTERPRETATION OF ANNULAR STRUCTURES ON SPACE PHOTOGRAPHS AND THEIR CORRELATION WITH GEOPHYSICAL FIELDS AND STRUCTURE OF EARTH'S CRUST IN TERRITORY OF USSR

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 86 (manuscript received 26 Apr 85) pp 43-50

[Article by A.T. Zverev and Ya. G. Kats, Geology Faculty, Moscow State University imeni M.V. Lomonosov]

[Abstract] The relationship between annular structures in the territory of the USSR and geophysical fields and structure of the earth's crust was clarified by use of correlation and factor analysis and the closeness of their interrelationship to the most important structures of the lithosphere was determined. A study was made of the correlation between annular structures and the rate of present-day vertical movements of the crust, amplitude of neotectonic movements, basement relief, gravity and magnetic anomalies, crustal thickness, age and density of age boundaries in the basement, density of mantle-crustal blocks, geothermal gradient and local isostatic anomalies in the lithosphere. The analysis yielded clear evidence that the annular structures interpreted on space photographs both for the USSR and elsewhere in the world are very closely related to geophysical fields and crustal structure. Genetic relationships between annular structures and crustal structure are revealed most clearly by factor analysis. Such an analysis indicates close paragenetic relationships between annular structures and crustal thickness, recent neotectonic movements, age of the basement, density of matter and geothermal regime of mantle-crustal blocks. Annular structures of all types have had a long history of development. In the USSR an increase in the density of annular structures is usually observed in regions of reduced crustal thickness and an increase in the density of matter, as well as increased heat flow. With respect to the relationship between the density of annular structures and the magnetic field, density increases with a relative increase or decrease in magnetic field strength. Figures 5; references: 11 Russian.

5303/8309
CSO: 1866/93

UDC 528.77:550.814:552.31+629.78

USE OF SPACE PHOTOGRAPHS IN DETECTING AND GEOLOGICAL AND GEOPHYSICAL STUDY OF HIDDEN PLUTONS IN EARLY PROTEROZOIC TROUGHS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 86 (manuscript received 23 Apr 85) pp 51-56

[Article by D.M. Trofimov, N.A. Strakhova, V.A. Bogoslovskiy, Ye. B. Ilina, V.A. Kazantsev and E.N. Kuzmina, Geology Faculty, Moscow State University imeni M.V. Lomonosov]

[Abstract] The interpretation of remote materials from the territory of the Kursk Magnetic Anomaly made it possible to detect a number of major isometric morphostructures. Their positions in the Precambrian basement indicated that they are situated within the limits of Early Proterozoic troughs. The studied morphstructures had a diameter of more than 20 km. It was determined that it is possible to detect hidden plutons on the basis of a group of remote and geological-geophysical data. The following combinations of structural elements corresponding to hidden plutons could be discriminated: isometric morpho-structures with a centrifugal structural pattern corresponding to arched rises in modern relief; discontinuous boundaries in the platform mantle and basement; numerous vein formations and hydrothermal changes in Precambrian rocks (and others). The depths of the plutons, their composition and interrelationship to basement rocks were determined by spatial analysis of initial and transformed gravity and magnetic fields. Maps at 1:200,000 and 1:50,000 were analyzed; gravity anomalies scaled to the upper half-space at altitudes 0 .25-20 km were used; the magnetic field was also scaled into the lower half-space. Estimates were made of depths of gravitating and magnetic masses. The method is illustrated in the example of the major Aleksandrovsk pluton, corresponding to a volcanic-plutonic complex in Lower Proterozoic rocks. The method is effective in planning search for minerals in the crystalline basement where it is overlain by a platform mantle. Figures 4.

5303/8309
CSO: 1866/93

UDC 634.434+551.4:634.11

EVALUATING EFFICIENCY OF USE OF SPACE INFORMATION IN STUDYING FORESTS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 86
(manuscript received 20 Jun 85, after revision 19 Mar 85) pp 57-62

[Article by Yu. V. Sukhotin and V.S. Kudryavtsev, "Lesproyekt" All-Union Aerial Photographic Forest Management Association, Moscow; Central Economics-Mathematics Institute, USSR Academy of Sciences, Moscow]

[Abstract] The great investments involved in collecting data make it essential to evaluate the cost effectiveness of use of space information in the study of forests. In such an evaluation of cost effectiveness it must be taken into account that the space system is used simultaneously for the study of other natural resources. In such an evaluation a very great number of factors and combinations of factors must be taken into account. The procedures developed on the basis of use of space information in the study of forests reduce the material and financial expenditures and increase the productivity of labor by a factor of 4-5. The need for aerial surveys is also reduced by a factor of 5. These new methods substantially reduce the amount of work actually done in the forest, which is replaced by office processing. A countrywide survey of forests can be made without any increase in expenditures. Methods for inventorying forest resources have been greatly improved by use of space information. In addition, it must be taken into account that the quality of the information is better and it can be obtained more quickly and on a more routine basis. An important use of space information is an on-going evaluation of the anthropogenic effect on forests and the effects of storms and fires. All this is taken into account by a series of cost-effectiveness indices. [The formulas and indices used in such evaluations are given and used in examples of specific calculations.] References: 3 Russian.

5303/8309
CSO: 1866/93

UDC 551.521.14

DETERMINING SEA SPECTRAL BRIGHTNESS COEFFICIENT USING AIRCRAFT MEASUREMENTS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 86 (manuscript received 4 Apr 85) pp 63-70

[Article by A.P. Vasilkov, O.A. Yershov and A.I. Sudbin, Institute of Oceanology imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] The spectra of ascending radiation (brightness) in the atmosphere measured from a helicopter at altitudes up to 5 km near the Black Sea coast were analyzed. After correction for the influence of the atmosphere these data were used in retrieving the spectra at sea level. Atmospheric correction was based on a method proposed by H. R. Gordon (APPL. OPT., Vol 17, No 10, pp 1631-1636, 1978). The spectral brightness of ascending radiation $B_H(\lambda)$ at different altitudes H was measured with a photometer mounted in a hatch in the floor of a Mi-8 helicopter. The $B_H(\lambda)$ measurements were made in eight spectral ranges discriminated by interference filters with λ_{eff} 370, 432, 437, 498, 537, 578, 671, 748 nm. Measurements of ascending radiation were made over the sea with a distance from the shore up to 30 km in a region of uniform waters, with a clear sky and with waves not greater than classs 2. The $B_H(\lambda)$ brightness was measured alternately in eight channels during horizontal linear flight at 100 km/hour; measurements were made at altitudes 50, 100, 200, 300, 500 m, 1, 2, 3, 4, 5, km. The experimental data were used in computing the spectral brightness coefficients of the sea-atmosphere system, water brightness coefficient, haze brightness and brightness of ascending radiation at 100 m. The spectral optical thickness of the atmosphere was registered as well, simultaneously with $B_H(\lambda)$. Eight series of measurements were made. It was found that for flight altitudes greater than 1 km the influence of the atmosphere must be taken into account in order to determine the spectrum of ascending radiation at sea level. The atmospheric correction method used makes it possible to retrieve the spectral brightness coefficient of sea waters in the range 400-700 nm with a maximum possible error $\sim$0.01 for flight altitudes $H \geqslant 2$ km. It is essential to make simultaneous measurements of spectral atmospheric transparency. Figures 3; references 14: 6 Russian, 8 Western.

5303/8309
CSO: 1866/93

UDC 528.813+631.1

DETERMINING MOISTURE CONTENT OF NONUNIFORMLY MOISTENED GROUND FROM SURFACE TRANSITION LAYER USING DATA FROM SPECTRAL MICROWAVE RADIOMETRY MEASUREMENTS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 86 (manuscript received 27 Feb 85) pp 71-78

[Article by Ye. A. Reutov and A.M. Shutko, RAdio Engineering and Electronics Institute, USSR Academy of Sciences, Moscow]

[Abstract] The previous research on this subject (ISSLED. ZEMLI IZ KOSMOSA, No 1, 1985 pp 73-87) has been continued. In the earlier research the authors studied the microwave radiation characteristics of nonuniformly moistened ground and gave an evaluation of the moisture content profile using data from remote microwave-radiometric measurements. Now the inverse problem has been solved. It was found that on the basis of the degree and nature of influence on microwave radiation characteristics all nonuniformly moistened ground can be classified into two types of moisture content state. In type I moisture content changes monotonically from the soil surface in conformity to some law and within the limits of the effectively radiating layer does not have sharp changes; the spectral differences of the radiation characteristics are usually small; in type II there is a thin transition layer at the soil surface in which moisture content has very great gradients and below this layer moisture content changes monotonically; the spectral differences of radiation characteristics are frequently very great. Only type II was investigated (type I was examined in the earlier research). A model is proposed for this purpose. The adequacy of the model was tested in the laboratory and in situ from an aircraft laboratory along control lines with synchronous surface measurements. The in situ tests were made in the Uzbek, Turkmen, Moldavian and Estonian SSRs, Odessa, Saratov and Dnepropetrovsk Oblasts, in Krasnodar Kray, in Bulgaria and Hungary. Control lines 1 to 9 km in length were used. Surface points were 300 to 600 m apart; soil moisture content was measured to depths 50-90 cm. Aircraft measurements were made at wavelengths 2.25, 18 and 30 cm. Flights were at 20-60 m. These experiments made it possible to estimate the thickness of the transition layer with an error 0.8 cm and moisture content at the lower boundary of this layer with an error 0.04 g/cm^3. Figures 5; references 5: 3 Russian, 2 Western.

5303/8309
CSO: 1866/93

UDC 535.361.2+57.084.2:535.232.65

USE OF LASER SYSTEMS WITH SPATIALLY SEPARATED RECEIVING CHANNELS FOR REMOTE STUDY OF PHYTOMETRIC PARAMETERS OF VEGETATION

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 86 (manuscript received 30 Jan 85) pp 84-87

[Article by V.A. Kanevskiy, V.F. Ryazantsev, Ya. I. Movchan, O.A. Perekrest, P.P. Fedchenko, V. Ye. Motok and P.P. Tsapesh, Botany Institute imeni N.G. Kholodnyy, Ukrainian Academy of Sciences, Kiev; Center for Automation of Scientific Research and Metrology, Moldavian Academy of Sciences, Kishinev]

[Abstract] An experiment was carried out with a helicopter laser complex for checking the conclusions of mathematical modeling for a possible evaluation of phytometric parameters of the vegetation cover on the basis of measurement of the characteristics of the scattering indicatrix of vegetation for two close directions in the backscattering region. Various types of crops were sensed with pulsed laser radiation in the UV range (337 nm) and the intensity of radiation scattered by vegetation was measured in two close backscattering directions by two spatially separated photodetectors. Flight altitude was 30 m; distance between the photodetectors was 1.5 m; the repetition rate of the laser pulses was 100 Hz; diameter of the laser spot on the vegetation surface was 3 cm. Flight time over selected fields averaged 60 s, which ensured an average of 6,000 measurements of the intensity of scattered laser radiation for each of the two selected scattering directions. The intensity of each of the reflected pulses was measured in 128 gradations. The results of measurements for each field were represented in the form of two histograms of the distribution of the amplitudes of reflected laser radiation pulses corresponding to the two scattering directions. Such histograms were obtained for corn, hay, barley, wheat and peas. It was found to be feasible to catalogue histograms of the distribution of amplitudes of reflected laser radiation for the remote indication of the phytometric parameters of crops related to their phytomass and development phase. Figures 5; references: 4 Russian.

5303/8309
CSO: 1866/93

UDC 681.3.01:519.67

FAST ALGORITHM FOR CLUSTER ANALYSIS OF IMAGES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 86 (manuscript received 4 Jan 85) pp 88-98

[Article by D.A. Denisov, Leningrad Electrotechnical Institute imeni V.I. Ulyanov (Lenin)]

[Abstract] Digital processing of space images by the cluster analysis method was studied. The method involves segmentation of images into fields allowing meaningful interpretation. In cluster analysis uniform groups are discriminated, with subsequent representation of the results of this grouping on the image plane. However, segmentation by the cluster analysis method can be very time consuming and could require several hours of computer time. This dictated the need for finding speedy clustering procedures equal in quality to the results obtained by use of traditional processing procedures. It was most important to eliminate excess computations at the algorithmic level. A method was formulated for eliminating this excess and a speedy algorithm was developed for clusterization purposes. Synthesis of this algorithm is described in detail, as are the methods employed in reducing the excess and the procedures employed in testing the algorithm. The proposed algorithm is intended for the clusterization of scalar fields of an arbitrary physical nature. Its generalization for a multidimensional case is not difficult. Figures 3; references 9: 8 Russian, 1 Western.

5303/8309
CSO: 1866/93

UDC 681.3:528.7

ORGANIZING DIGITAL DATABASE FOR AUTOMATED FOREST MAPPING

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 86 (manuscript received 16 Jan 85) pp 104-110

[Article by Ye. D. Bodanskiy, D.A. Starostenko and R.I. Elman, "Lesproyekt" All-Union Aerial Photographic Forest Management Association, Moscow]

[Abstract] A digital cartographic database for use in forest management was developed. All different types of raw data available were in one way or another incorporated into this datebase. All the data to be included were analyzed in order to ensure most effective organization of the database. A series of formats had to be perfected for special reduction of areal, linear, and point information. Numerous steps had to be formulated for an integration of all materials to ensure total and speedy retrieval. The database consists of independent parts which were organized separately. All data are reduced to magnetic disks constituting sets of tables of characteristic features and reference tables. The organization and maintenance of the database is ensured by a specialized database control system developed by specialists of "Lesproyekt." References: 3 Russian.

5303/8309
CSO: 1866/93

UDC 528.85:551.24

AUTOMATED INTERPRETATION OF SPACE PHOTOGRAPHS FOR PURPOSE OF STRUCTURAL ANALYSIS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 86 (manuscript received 19 Mar 85) pp 111-118

[Article by N.V. Koronovskiy, A.A. Zlatopolskiy and G.N. Ivanchenko, Moscow State University imeni M.V. Lomonosov; "Aerogeologiya" Geological Production Association, Moscow]

[Abstract] Two "Landsat" space photographs covering the territory from the meridional course of the Terek River in the west to Makhachkala in the east and the Main Range of the Greater Caucasus in the south to the region of the latitudinal course of the Terek in the north were used in an automated analysis of the lineament network. The studied area has numerous petroleum and gas deposits. Image processing was with the "Prognoz" computer complex. Work was done in two stages. In the first, short lines were defined which provided the pattern of fissuring. In the second, series of maps were compiled for characterizing different properties of the fissuring field. These maps included: map of the overall density of fissuring obtained by summation of densities in all directions; map of the dispersion of fissuring; map of sample resultant length; map of distortion coefficient. The majority of the lineaments form close-lying systems and are grouped in lineament zones with a width of 10-30 km; only meridional lineaments do not form such zones; lineament zones of latitudinal, northeasterly and north-northeasterly strikes are best expressed; within the lineament zones each lineament consists of discontinous segments of different length; lineaments and lineament zones have a nonuniform spatial distribution. It was noted that petroleum deposits are associated with intersections of lineaments of different directions (zones of increased fissuring and permeability). Figures 3; references: 4 Russian.

5303/8309
CSO: 1866/93

UDC 551.243

POSSIBLE NATURE OF MANY ANNULAR STRUCTURES OBSERVABLE ON SPACE PHOTOGRAPHS

Novosibirsk TIKHOOKEANSKAYA GEOLOGIYA in Russian No 1, Jan-Feb 86 (manuscript received 10 Nov 84) pp 100-102

[Article by G.F. Ufimtsev, Institute of Earth's Crust, Siberian Department, USSR Academy of Sciences, Yakutsk]

[Abstract] Annular features discovered on other planets of the earth group have frequently been likened to corresponding features on the earth's surface. However, many annular structures are visible on one space photograph but are not visible on others; moreover, not all such annular structures have explicit spatial (paragenetic) relationships to the geological structure. Unconvincing arguments are often presented in endeavoring to find such inter-relationships. In actuality, the relief and geological structure of certain regions in the eastern USSR are characterized by strictly annular forms and combinations of annular and linear elements. Specific examples of such formations on the Siberian platform and in the Far East are discussed. In particular, the hydrographic network is characterized by many annular and arcuate elements. Many other such forms are a selective reflection of geological structure elements. The selective reflection of planetary fissuring systems is determined by landscape conditions, especially the meteorological situation, accounting for the presence of images on some photographs and their absence on others. The planetary fissuring system can be represented in the form of an eight-pointed star or in the form of an octagon close in configuration to a circle. These can be interpreted as annular structures. Figures 1; references: 4 Russian.

5303/8309
CSO: 1866/106

UDC 551.435(574):629.78

SOME ASPECTS OF PLANNING RAILROADS UNDER COMPLEX NATURAL CONDITIONS USING SPACE SURVEY MATERIALS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 85 (manuscript received 5 Nov 84) pp 58-60

[Article by A.I. Bogdanov, Moscow Institute of Railroad Transport Engineers]

[Abstract] A method has been developed for selection of the track to be followed by a planned railroad line considering prediction of various physical processes based on data obtained by interpretation of images made from space. The area through which the track is to pass is divided into zones as a function of the degree of tectonic irregularity. Within each zone, the frequency of icing is computed. The probability of ice formation is employed in a quantitative estimate of the costs of construction of the railroad line and the cost of operating the railroad after construction. The equations presented for prediction of the development of ice during planning of railroad lines can be used to develop methods for prediction of slides, avalanches, karsts and other factors as well. The method thus allows evaluation of various possible paths for a planned railroad line considering the prediction of various exogenous processes on the basis of interpretation of images made from space. Figure 1, references: 4 Russian.
[31-6508]

UDC 528.8.044+551.482.215

RADAR OBSERVATION OF RIVER FLOODS FROM THE COSMOS-1500 SATELLITE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 85
(manuscript received 20 Mar 85) pp 61-66

[Article by A.P. Pichugin, Institute of Radiophysics and Electronics, Ukrainian Academy of Sciences, Kharkov]

[Abstract] Radar images made from space can be useful for monitoring and diagnosis of flooding of rivers. The side-looking radar on the Cosmos-1500 spacecraft has been useful in studies of ice cover and the surface of the ocean. This article describes its use to study river flooding. A figures shows a radar image obtained on 20 August 1984 during flooding of the Amur River, clearly showing areas covered with water as darker areas due to reduced back scattering. Radar observations from space can record flooding of rivers and monitor the major parameters of flooded areas. The methods suggested in this article for processing radar information allow computation of areas with varying degrees of flooding, as well as values of relative areas under water. These methods, considering that radar observations are independent of weather conditions, can be useful for monitoring flooding of rivers for timely decision making.
Figures 5; references: 1 Russian.
[31-6508]

UDC 621.397.13(201):681.785.5:535.243+535.241.13:534

CONSTRUCTION OF VIDEO SPECTROMETRIC AND SPECTRAL-ADAPTIVE TELEVISION SYSTEMS BASED ON ACOUSTICOOPTICAL FILTERS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 85 (manuscript received 11 Feb 85) pp 67-75

[Article by G. Ya. Byymistryuk, V.A. Vavayev, V.B. Voloshinov, B.S. Zhukov, L.N. Magdich, V.N. Parygin and P.I. Shintser, Institute of Space Research, USSR Academy of Sciences, Moscow; Moscow State University imeni M.V. Lomonosov; All-Union Correspondence Electric Engineering Institute of Communications, Moscow]

[Abstract] Video spectrometers and multispectral television systems for use in surveying natural resources must be tunable automata capable of adapting to change in the spectral-energy structure of the surface studied. This requires the use of elements capable of adjusting their parameters and characteristics under the influence of electric control signals. Acoustico-optical filters are now solid state devices with electrically controlled spectral transmission characteristics, based on Bragg diffraction upon interaction of optical radiation with ultrasonic oscillations in an anisotropic birefringent crystal. The functioning of these devices is diagrammed and briefly explained. The completely electronic nature of control of an acoustico-optical filter facilitates interface with a microprocessor-based control and data processing subsystem. The use of acoustico-optical filters as image filters allows the creation of high speed video spectrometers, television systems which measure the spectral distribution of brightness of surface fragments and form sequences of two-dimensional spectral images. Spectrally adaptive television systems form spectrally compatible images in order to increase the distinguishability of objects against a background with a priori unknown or variable spectral-energy characteristics. Further development and improvement of video spectrometric and spectrally adaptive television systems will involve more complete utilization of the functional capabilities of acousticooptical filters, photosensitive instruments with charge-coupled devices and charge-injection devices. Problems will arise in the development of improved spectral adaptation algorithms based on such parameters as speed, accuracy, sensitivity and change in spectral-energy structure of objects. Figures 5, references 17: 10 Russian, 7 Western.
[31-6508]

UDC 528.531.3

CREATION OF TESTS FOR EVALUATION OF TRANSFER FUNCTION OF THERMAL IMAGING CHANNELS OF AIRCRAFT SCANNING RADIOMETERS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 85 (manuscript received 17 Oct 84) pp 91-94

[Article by A.Z. Lapshin, N.I. Dvoretskiy, V.M. Movshovich, N.Kh. Nikulin, and M.B. Sobolevskiy, All-Union Scientific Research Center 'AIUS-Agroresursy', Moscow]

[Abstract] The shortcomings of laboratory and theoretical methods of determination of the parameters of hardware force researchers to estimate these characteristics under natural conditions. Attempts have been made to use for these purposes thermal targets consisting of open reservoirs of water and heated concrete plates. The dimensions of these targets are such that in most cases they cannot be used to evaluate the frequency-contrast characteristics of medium-resolution apparatus. The authors have developed a method for creating artificial dynamic thermal targets for estimation of the frequency-contrast characteristics of apparatus. Strips of a polyethylene tetraphthalate film are laid out on a cleared field and attached around the edges by long metal pins. The films effectively reflect visible and IR radiation from the sun, causing the areas beneath the films to be much cooler than areas around them after a few hours of sunshine. At noon, the film is removed and the thermal target thus formed is measured, the temperature of the surface being measured manually at the same time.
Figure 1, references: 3 Russian.

[31-6508]

UDC 535.247:519.24

RELATIONSHIP OF OPTIMAL NUMBER OF PROCESSED SPECTRA TO SPATIAL RESOLUTION OF APPARATUS FOR REMOTE INVESTIGATION OF NATURAL OBJECTS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 85 (manuscript received 29 May 84) pp 95-98

[Article by A.F. Yanovskiy, Ye.A. Yanovskaya, Institute of Physics, Belorussian Academy of Sciences, Minsk]

[Abstract] The purpose of this work was to develop a basis for criteria for estimating the homogeneity of natural objects and the optimal number of measurements using a spectrometer with assigned spatial resolution. As an example, results are studied from measurement of the spectral brightness coefficient obtained in studies of a forested area, a natural object with chaotically repeating changes in color tone, from a helicopter at various altitudes using an MSS-2 spectrometer with 8 percent relative random error of measurement of spectral brightness coefficient. Establishment of the fact of homogeneity of the structure of an optical field in a natural object requires preservation of the mean value of coefficient of spectral brightness relative to individual samples with unchanged experimental conditions and status of the object. The method here suggested was tested under field conditions in photometry of potato fields with an error of measurement of coefficient of spectral brightness of 6 percent. In continuous spectrometry using apparatus with selective spatial resolution the method allows estimation of the homogeneity of the spectral samples, decreasing the number of brightness measurements for an assigned measurement error and yielding invariant characteristics interrelating radiation and object-specific characteristics of natural objects. Figures 2, references: 6 Russian.

[31-6508]

UDC 528.7:681.3

RELATIONSHIPS FOR ERRORS OF TRANSFORMATION IN AUTOMATED MAPPING OF FORESTS BASED ON SPACE PHOTOGRAPHS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 85 (manuscript received 4 Oct 84) pp 99-105

[Article by Ye.D. Bodanskiy, D.A. Starostenko, and R.I. Elman, All-Union Aerophoto Forestry Association 'Lesproyekt', Moscow]

[Abstract] An analysis of factors causing errors in analytic transformation during automated cartography of forest land based on space photographs shows that the most important are errors in determination of the coordinates of reference points leading to errors in determination of the projective transform parameters. Other factors such as the curvature of the earth, aberration of optical systems, atmospheric distortions, chemical photographic process factors and methodologic errors in computation (such as rounding) result in fewer errors and are not studied in this article. The matrix equation derived in this article is linear for the transforming factors involved. As an example of the use of the equations derived, a procedure is presented for rejecting reference points, the coordinate errors of which significantly exceed the a priori values of limiting deviations for the two-dimensional case. This procedure can be performed if the number of reference points is greater than the minimum necessary number. References 7: 6 Russian, 1 Western.

[31-6508]

UDC 551.510.534

COMPARATIVE ANALYSIS OF INFORMATION CONTENT OF SYSTEMS OF AEROLOGIC AND REMOTE SOUNDINGS OF THE ATMOSPHERE IN THE NORTHERN HEMISPHERE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 85 (manuscript received 27 Jun 84) pp 106-116

[Article by O.M. Pokrovskiy, A.I. Belyavskiy, and S.G. Denisov, Main Geophysical Observatory imeni A.I. Voyeykov, Leningrad]

[Abstract] The object of study in this article is the aerologic network of the northern hemisphere, its major regional components and the remote thermal atmospheric soundings system implemented by means of weather satellites in polar orbits. The task of the article is to estimate a three-dimensional field based on a set of direct and indirect observations performed over an arbitrary set of points. With correct processing of data from satellite measurements, the relative information contribution of the remote thermal soundings system is 10 to 15 percent in the northern hemisphere, 60-90 percent with respect to regional subsystems in the aerologic network. Therefore, in certain situations the remote thermal soundings system may have supplementary role. The significant variability of information characteristics of the aerologic subsystems depending on location of stations makes efficient placement of stations based on solution of optimization problems difficult. References 13: 10 Russian, 3 Western.

[31-6508]

UDC 528.8.044+528.813

ESTIMATION OF EFFECTIVENESS OF LASER SOUNDINGS OF THE ATMOSPHERE FROM A SATELLITE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 85 (manuscript received 4 Jan 85) pp 117-122

[Article by V.Ye. Zuyev, B.P. Ivanenko, and I.E. Naats, Institute of Atmospheric Optics, Siberian Division, USSR Academy of Sciences, Tomsk]

[Abstract] In order to estimate the effectiveness of a previously suggested approach for interpretation of optical data and study the information capabilities of two-wave atmospheric ozone soundings from satellites, the authors suggested a series of numerical experiments. The resolution of the two-wave soundings method is studied and the error in restored atmospheric ozone density profiles is estimated. Installation of lidars on board satellites for monitoring the concentration of atmospheric ozone is considered a realistic and promising step, allowing systematic global studies of the space-time variability of ozone concentration at altitudes up to 50 km. Figures 4; references 12: 7 Russian, 5 Western.

[31-6508]

UDC 581.9:654.949:531.3

MEASUREMENT OF ECOLOGIC TENDENCY OF DESERT FORMATION BASED ON REPEATED AERIAL AND SPACE SURVEYS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 285, No 5, Dec 85 (manuscript received 18 Jun 85) pp 1269-1272

[Article by B.V. Vinogradov, V.V. Lebedev, K.N. Kulik, and A.N. Kaptsov, Institute of Evolutionary Morphology and Ecology of Animals imeni A.N. Severtsov, USSR Academy of Sciences, Moscow; Center for Training of Cosmonauts imeni Yu.A. Gagarin; All-Union Scientific Research and Agricultural Land Reclamation Institute, Volgograd]

[Abstract] Repeated surveys from space can be used to determine the contemporary trend in ecologic dynamics. This article studies the dynamics of desert and pasture ecosystems in the Kalmytskaya ASSR, among the largest centers of desertification in the USSR. Desertification areas are seen to expand in successive maps based on interpretation of aerial surveys from 1954 through 1979. Successive aerial survey and space survey data plus observations from the surface between 1954 and 1984 are used to develop a mathematical expression of the trend of the dynamics of the foci of desertification in this area. Figure 1, references 5: 4 Russian, 1 Western.

6508/8309
CSO: 1866/66

INTERVIEW WITH CHIEF OF GLAVKOSMOS INTERNATIONAL LIAISON DEPARTMENT

Moscow MOSCOW NEWS in English No 25, 22 Jun 86 p 10

[Interview with Glavkosmos International Liaison Department Chief Stepan Bogodyazh by Mikhail Chernyshov: "Glavkosmos: Cooperation and Coordination"]

[Text] Glavkosmos is the acronym of a new government agency which has recently been set up and started functioning--the USSR Main Administration for the Development and Utilization of Space Technology for the National Economy and Research.

"The scope of the work on space technology has now reached such dimensions," says Stepan Bogodyazh, chief of Glavkosmos' International Liaison Department, "as to necessitate the establishment of a special agency to coordinate practical work and research in this field, as well as fulfillment of the USSR's commitments stemming from agreements with other countries and organizations."

[Chernyshov] Until recently, the coordination of work under programs of international cooperation proceeded mainly through the USSR Academy of Sciences via the Interkosmos Council. Have any changes occurred in this respect?

[Bogodyazh] The USSR Academy of Sciences, as the country's main scientific center, has always been, and remains, the leading organization in selecting scientific trends carried out in space if it comes to a national program. In international research programs the academy handles these questions jointly with the scientific organizations of countries involved in this or that form of cooperation. Glavkosmos, for its part, establishes what technical means can be most effective in carrying out research, that is, what kind of satellites, ships or orbital stations, what should be the time limits, and so on. It does this, of course, in cooperation with the manufacturers of space equipment.

[Chernyshov] Various levels can be identified in the development of international space cooperation which now exists in the most diverse forms. Sometimes joint research is at an initial stage, but somewhere development projects pass over into the category of practically functioning systems. In addition to this, in the sphere of space communication, for instance, international associations, whose interrelationships are built on a purely commercial basis, have long been in existence.

[Bogodyazh] Financing joint projects and existing systems is an intricate issue. The Soviet Union has made a big contribution to the development of international programs of cooperation in space. About three dozen satellites and more than ten high-altitude geophysical rockets have been launched and eleven international flights have been carried out with the participation of cosmonauts from those socialist countries belonging to Interkosmos, as well as France and India, through Interkosmos and on the basis of bilateral agreements. The Vega project has been realized in the sphere of interplanetary flights with the participation of six socialist and three West European countries. In all these projects the Soviet Union provided its partners in cooperation with carrier-rockets and spacecraft, manned ships and orbital stations. Each blastoff is ensured by cosmodrome services, control centers and tracking stations--the expense of which comprises the bulk of the financial outlays on any of these projects. But the participants in cooperation did not conduct any settling of financial accounts. The same principles now underlie the preparation for a Soviet-Syrian manned flight and the training, due in September, of three French candidates for a durable expedition to be carried out on a Soviet orbital station. The international project Phobos, in which ten countries are taking part, is being realized in a similar way in the sphere of interplanetary flights. The USSR, naturally, has rendered and will continue to render assistance to the international programms geared to the peaceful exploration and utilization of space, but today in a number of cases the questions of financing already require different approaches, especially when it comes to the introduction of some practical systems.

[Chernyshov] Reference here can obviously be made to the example of intersputnik.

[Bogodyazh] The Intersputnik international system of satellite communication has been in existence since 1971 and now comprises 14 countries. Approximately another 15 countries, formally not members of the Intersputnik, also use its services. All the main questions are decided by this organizations' council on the "one country-one vote" principle. In this, Intersputnik differs from many other systems where the votes are distributed in accordance with the capital invested. Membership in Intersputnik has no political, economic or social strings attached, nor does it infringe upon the right of every state to use other international communication systems as well. All members have the benefit of a single rate on the use of channels, which is lower than in other analogous systems.

[Chernyshov] It is supposed that the forthcoming launch of India's satellite intended for the study of natural resources will be carried out for the first time on a commercial basis. Why is this?

[Bogodyazh] The Soviet Union has assisted India in the manufacture and launching of three satellites--the Aryabhata research satellite and two Bhaskara experimental satellites for natural studies. Both these vehicles, as well as the joint manned flight, have produced considerable economic effect.

India's cooperation with the Soviet Union--this has been admitted by all Indian specialists--has had a big role to play in the rise of Indian cosmonautics. The nature study satellite, which is expected to be launched in the first half of 1987, will already become part of the operational system. We believe that, in this respect, a transition to commercial relations is justified.

[Chernyshov] At the latest COSPAS-SARSAT session held in Leningrad, the participants in this international satellite system said that the financing of its operation requires appropriate regulation. What can be said on this score now?

[Bogodyazh] Work on rescue satellites has been in progress since 1977, but the transition to the practical phase dates back, in all probability, to 1982 when the first Soviet rescue satellite Cosmos-1383 began to function in orbit. Now the system has three Soviet satellites of the Cosmos series and two American satellites. Initially the system was formed by four countries: the USSR, the United States, France and Canada. Now it has been joined by Britain, Bulgaria, Denmark and Norway.

Experience has shown that the COSPAS-SARSAT system helps quickly and with a high degree of accuracy to locate the coordinates of sea and air accidents. On average in no more than an hour rescue services receive distress signals. Today the countries participating in the system already have about 300,000 portable bouys (radio transmitters) capable of sending a distress signal via satellite. Approximately 500 human lives have already been saved thanks to this system.

[Chernyshov] The United States has repeatedly tried, and has not given up attempts today, to dictate its will to impose unequal relations in many spheres of international space cooperation.

[Bogodyazh] This is so. There was a time when much was written in the United States, for instance, about its intentions to contribute, using space Shuttles, to the development of international manned flights, but so far the Americans have less international flights to their credit than the USSR and they have made practically all their partners pay in advance for these flights. And in other areas of purely commercial relations as well, the United States' actions sometimes hold no water. Its stand in relation, for instance, to the Soviet Proton rocket, which was suggested as the carrier for the satellites of the Inmarsat international system for ship-to-shore communication, can serve as a "classical" example of bias. The Soviet proposal is beneficial for the Inmarsat financially and otherwise. But profiting by its influence on British firms, the American side has been doing all it can to exclude the Soviet Proton from the list of contenders. Perhaps the Proton's reliability, for instance, causes some doubts? The rocket has been in operation for over 20 years and was used to put into orbit the most diverse facilities, including communication craft for the Intersputnik system. According to statistics, the Proton's reliability is in no way worse but, on the contrary, higher than that of American rockets.

[Chernyshov] Obviously, there is an ever more imperative need for a settlement of both legal and financial relations on a much broader scale than ever in the past.

[Bogodyazh] This is really so. And this is one of the reasons why the Soviet Union has suggested the setting up of a world space organization on international cooperation for the peaceful exploration and utilization of outer space. In its framework it would be possible both to render more effective assistance to countries which do not yet have the facilities for developing space research, and to implement, in common, large-scale projects of fundamental and practical application. Clearly, this mechanism will be able to function with success only if weapons have no access to space.

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CSO: 1852/6

MEMORANDUM SIGNED ON SOVIET-FRENCH MANNED MISSION IN 1988

Leningrad LENINGRADSKAYA PRAVDA in Russian 8 Mar 86 p 3

[Text] In line with a summit-level accord reached during the official visit to France by M.S. Gorbachev, General Secretary of the Central Committee of the Communist Party of the Soviet Union, a memorandum regarding preparations for a joint manned flight was signed by Soviet and French delegations in the presidium of the USSR Academy of Sciences on 7 March. Plans call for the second Soviet-French space mission to be carried out in 1988 on board a Soviet spaceship and orbiting station. Scientists of both countries have begun preparing a scientific program for a prolonged mission.

The memorandum was signed by academician V.A. Kotelnikov, vice-president of the USSR Academy of Sciences and chairman of the "Intercosmos" council; A.I. Dunayev, head of the Main Administration for Development and Use of Space Technology for the Economy and Scientific Research (Glavkosmos SSSR); and Jacques-Louis Lyons, president of France's National Center for Space Research.

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COMMENTARY ON SOVIET-FRENCH COOPERATIVE SPACE PROGRAMS

Moscow IZVESTIYA in Russian 20 Feb 86 p 4

[Article by Yu. Kovalenko, Izvestiya correspondent: "Cooperation in Space"; capitalized passages published in boldface]

[Text] Paris, 20 Feb--A FOREIGN POLICY EVENT OF CRITICAL IMPORTANCE TO FRANCE WAS THE VISIT OF SECRETARY GENERAL M. S. GORBACHEV. IT IS REPORTED HERE THAT HE HAS HELPED IN IMPROVING THE CLIMATE IN EUROPE AND AROUND THE WORLD, RENEWAL OF THE DIALOGUE BETWEEN EAST AND WEST, EXPANSION OF POLITICAL CONSULTATIONS AND DEVELOPMENT OF SCIENTIFIC-TECHNICAL AND COMMERCIAL-ECONOMIC TIES.

QUESTIONS OF PEACEFUL DEVELOPMENT OF OUTER SPACE OCCUPIED A SPECIAL PLACE IN HIGH-LEVEL SOVIET-FRENCH NEGOTIATIONS. THE JOINT EFFORTS OF BOTH COUNTRIES IN THIS FIELD ARE BEING CROWNED WITH VISIBLE SUCCESSES.

The cup of the antenna mounted atop one of the buildings of the Toulouse Space Center began to turn slowly. "This means (I was told) that a satellite is flying overhead and the antenna is receiving its signals. For example, when the satellite receives a distress signal it rebroadcasts it to the earth stations in the Soviet Union, France, USA and Canada. These relay the information to the appropriate rescue agencies, which immediately take the necessary measures."

"We could have saved all the passengers of the Titanic but, unfortunately, there was no international KOSPAS-SARSAT program for assisting ships and airplanes in distress at that time," explains scientist Claude Salmon, who heads the French portion of this program at the Toulouse Space Center.

International cooperation in this important field began several years ago, when an agreement was reached to combine the two systems: the Soviet KOSPAS and the SARSAT, in which France, the United States and Canada participate. Their goal is to offer assistance to expeditions, ships and airplanes in distress.

Salmon, who has been collaborating for almost two decades with Soviet scientists and has participated in many joint experiments, particularly the launching of satellites, is one of the veterans of the Toulouse Space Center, created in 1968 and part of the National Center for Space Research (CNES) of France.

Before coming to Toulouse, I spent some time at the Paris headquarters of the CNES. The chief of the public relations section, Daniel Metzlet, related the main stages of the Soviet-French cooperation for peaceful development of outer space, in existence for around 20 years. France was the first capitalist nation with which the Soviet Union signed an interstate agreement for cooperation in this field. It also includes areas such as space physics, space meteorology, space medicine and biology, space communications.

During these years, dozens of joint space experiments have been conducted. A French laser corner reflector was mounted aboard the Soviet Lunokhod-2. A Soviet booster rocket launched the French satellite Sneg, which performed gamma and x-ray investigations. The satellites Astron and Prognoz-9, placed in orbit in 1983, had joint-developed instruments on board. And, of course, the culmination of our cooperation was the joint flight aboard the Soyuz T-6 spacecraft and the Salyut-7 orbiting station.

On more than one occasion I have run across one of the participants, Jean-Louis Chretien. He always speaks with special feeling about the bonds of cosmic brotherhood connecting him to his Soviet friends. The main task confronting the cosmonauts of the world (he believes) is to join forces and prevent the militarization of space and stop the plans preparing for "star wars" across the ocean.

Two aerostat probes, delivered on 11 and 15 June 1985 together with the descent capsules to the planet Venus by the Soviet automatic stations Vega-1 and Vega-2, after flying for 46 hours at a height of 12,000 kilometers, gathered information about the temperature, wind force and pressure in the atmosphere.

"This was a triumph of science and, without exaggeration, also an historical day for us, the French scientists" explains the head of the French section of the Vega program at the CNES, Josette Runaveau. In Moscow, she along with her Soviet colleagues observed the descent of the probes to Venus.

"The findings are now being processed at CNES" she continues. "At the same time, we are preparing for the upcoming encounter of the space stations Vega-1 and Vega-2 with Halley's Comet, which will occur in March of the present year. The stations will photograph its core and send the picture to earth.

"Vega is the present of Soviet-French cooperation in the area of peaceful development of space. But what will tomorrow bring? Currently (relates Runaveau) our countries are preparing new joint experiments. In the spring of last year a Soviet-French agreement was concluded to study Mars and its satellite Phobos in the framework of a multilateral cooperation.

"In July 1988, two space stations will be launched from the Baykonur space center, carrying on board several instruments created by French scientists," explains Runaveau. "After seven months of flight, they will arrive at Mars and investigate the magnetic field and ionosphere of this planet. Then the vehicle will begin to study Phobos."

"We are very satisfied that both the USSR and France desire space to become an arena of peaceful cooperation, instead of military confrontation," observed M. S. Gorbachev at a speech in Paris. "The shoulders of our two countries are supporting more than 40 joint experiments in peaceful study of the circumterrestrial space, and now Venus and Halley's Comet as well. The experts in both countries propose to expand the mutual cooperation. I believe that political factors will support this."

Such statement of the question is dictated by the interests of our two countries and corresponds to the goals of expansion of international cooperation in the name of peace in space and on earth.

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CSO: 1866/73

FEOKTISTOV COMMENTS ON MANNED VERSUS UNMANNED SPACE RESEARCH, FUTURE TYPES OF ORBITAL STATIONS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 10 Apr 86 p 4

[Article by G. Lomanov, correspondent (interviewer)]

[Abstract] The article is a lengthy interview with Doctor of Technical Sciences Konstantin Petrovich Feoktistov on the advancement of manned space flight. He recalled flights of the manned program that marked new stages of advancement, and went on to comment on the role of manned missions in space exploration and application of the technology for economic ends. Asked about the contention of G. Babakin, chief designer of interplanetary stations, that there are no tasks in space which automatic devices could not accomplish, Feoktistov replied that to encompass the great multitude of tasks that are of interest, it would be necessary to develop dozens of automatic devices. The advantage of manned missions, Feoktistov pointed out, is that a cosmonaut is a flexible system; the cosmonaut can switch easily from one kind of task to another, which automatic devices still cannot do.

Asked what types of orbiting stations and spacecraft he sees in the future, Feoktistov listed a series of possible orbiting technology: specialized complexes for studying natural resources and for technological experiments and astrophysical studies; technical servicing stations which could receive spacecraft, fuel them and prepare them for specific tasks; and a base for building gigantic structures. He said the latter, for example, could be used to assemble radio telescopes with antennas having a diameter up to 1,000 meters, and to build power stations with solar panels having an area of 50-70 square kilometers.

Finally, Feoktistov said there could be orbiting stations of a type that he called "Oblako" (cloud), which he described as a rather compact 'swarm' of structures flying in the same orbit. The idea of this type of project would be that for specialized types of craft in such a 'swarm,' for example--ones with high-precision telescopes and ones for technological experiments requiring absolute zero gravity, the presence of cosmonauts on board them would be undesirable. The crews would have separate quarters in which to live and work, and would only visit the specialized craft from time to time in order to service them. Feoktistov said these colonies would have to fly in low orbits that would keep the crews safe from radiation. Because of the aerodynamic drag on the spacecraft, their orbit and their positions relative to one another would have to be corrected periodically.

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FEOKTISTOV COMMENTS ON PLANS FOR 'MIR' STATION AND LONG-RANGE DEVELOPMENTS

Moscow IZVESTIYA in Russian 23 Apr 86 p 3

[Article by B. Konovalov, Izvestiya science commentator (interviewer)]

[Abstract] The article is a lengthy interview with K.P. Feoktistov, pilot-cosmonaut of the USSR and Hero of the Soviet Union, concerning plans for work on the new orbiting station "Mir," and also ideas for future generations of space technology.

Feoktistov pointed out that the work of crews on the last "Salyut" stations proved that missions lasting half a year could become the norm, which he called an 'economically acceptable' period. Regarding the "Mir" station, Feoktistov said its principal distinguishing feature is the presence of the six docking ports, and he commented on the types of modules that this feature allows to be accommodated for specific scientific and technological tasks. Among other features of the "Mir," he mentioned the high degree of automation--it has several computers, as compared with the one computer carried on "Salyut" stations. They allow the control of the station and the operation of onboard equipment to be automated to a great extent. Fuel consumption for controlling the station has been minimized, and in the future, as modules are added to the station, Feoktistov said that use of fundamentally new systems that could provide even greater fuel economy is possible. He said the life-support systems remain physical-chemical ones, but they too are more economical than their predecessors.

Asked whether the "Mir" would be permanently manned, Feoktistov said that this is possible, that there are no technical obstacles to this. The present crew is testing all of the station's systems.

Asked to look ahead to future space technology, Feoktistov said that the next generations of orbiting stations would be 'orbiting bases.' They would be designed to receive and service other spacecraft. For example, they may receive satellites in a 'bundled-up' form in low orbits. At the orbiting base, these satellites would have their systems deployed, such as antennas, be checked out, and then boosted into higher orbits, including geostationary ones. An orbiting base also could service interplanetary spacecraft. Such spacecraft would require very large solar panels and antennas, which could be installed at the base. Feoktistov mentioned radio telescopes that could be 100 meters in diameter.

Feoktistov stated that he believes it is entirely possible to create solar power stations in space. They must be made of superlight structures with solar panels made of film material. For this to be feasible, he said means of putting the payloads into orbit would have to be tens and even hundreds of times less costly than today's launch vehicles. In addition, there would have to be economical boosters to lift structures from low orbits, where they would be assembled, into the geostationary orbits where solar power stations would have to operate. An antenna for transmitting 5-10 million kilowatts of power to Earth in the centimeter band of radio waves would need to have a diameter of approximately 1,000 meters, he estimated.

Feoktistov went on to observe that for such a project, international cooperation would be practically essential. Asked about a possible international manned flight to Mars, he said that although this idea is a very enticing one for him, he thinks it more economically expedient to contemplate the solar power station in space. For exploration of the outer reaches of the solar system, he said thought should be given to developing a kind of 'electronic person.' This machine would be more than a robot in the conventional sense, because it would need to have human-like traits and abilities such as a certain free will, curiosity, and ability to understand its environment and to accumulate knowledge. He said it would be an 'extention' of human reason, developed specially for life in outer space.

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SHATALOV COMMENTS ON COSMONAUT MISSIONS

Moscow VOZDUSHNYY TRANSPORT in Russian 12 Apr 86 p 3

[Article by B. Tril, correspondent (Moscow)]

[Abstract] The article is a lengthy interview on the occasion of Cosmonautics Day with General-Lieutenant of Aviation Vladimir Aleksandrovich Shatalov, USSR pilot-cosmonaut and director of training of Soviet and foreign cosmonauts in the USSR. Shatalov shares personal recollections of cosmonaut Yuriy Alekseyevich Gagarin, and he comments on results of space medical research and on current and prospective applications of space research in such fields as pharmaceutics and commercial aviation.

Asked about the problem of prolonging the working fitness of cosmonauts, Shatalov says that a goal of work in this direction should be to enable a cosmonaut to fly 10-15 space missions between the ages of 25 and 50. He mentions that although changes have been found to occur in the human organism as a result of frequent and prolonged space flights, studies show that the body returns to its initial condition in the course of a recuperative cycle which lasts a month, on the average.

Shatalov goes on to mention aspects of the space program which could benefit commercial aviation. Methods that are being used to ensure communications with the orbiting station "Mir" are said to provide a basis for broader introduction of satellite-aided communications with aircraft, for example. Whereas communications with space stations formerly could be maintained only while they were passing over Soviet territory or over scientific ships at sea, the zone of communications has not been expanded through the use of the stationary satellite "Luch," Shatalov explains. Asked about prospects for participation of civil aviation pilots in space missions, Shatalov points out that a former test-pilot of the aviation industry, I. Volk, is already a cosmonaut, and he foresees space flights by commercial pilots on a regular basis in the more distant future.

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DISCUSSION OF POSSIBLE FUTURE COMET AND PLANETARY MISSIONS

Moscow GUDOK in Russian 10 Apr 86 p 4

[Article by Vladislav Shevchenko, Doctor of Physical-Mathematical Sciences]

[Excerpt] The 25th anniversary of the launching of the first spacecraft to planets of the solar system is being marked this year. These flights were inaugurated by the Soviet automatic station "Venera-1" in February 1961. Dozens of automatic stations have been sent on interplanetary voyages in past years.

The latest and most impressive experiments in this series were the flights of the Soviet spacecraft "Vega-1" and "Vega-2," which carried out studies of the planet Venus en route to Halley's Comet, and also the flight of the U.S. spacecraft "Voyager-2," which obtained detailed information on the planet Uranus.

A scientific conference of planetologists took place in the U.S. city of Houston in March of last year. About 500 U.S. and foreign specialists attended this conference, at which prospects for study of the solar system were discussed.

The possibility of flights by spacecraft to the asteroid belt was examined, in particular.

One of the larger asteroids, Amphitrite, is of interest, for example. Obtaining detailed images of this asteroid's surface and spectra of its reflected radiation would make it possible to interpret available telescopic data, obtained on Earth, regarding a whole group of small planets, which number about 600 objects. An American station called "Galileo" could bring interesting data on Amphitrite, but its launch will probably be postponed for an indeterminate period as a result of the "Challenger" explosion.

The stations "Vega-1" and "Vega-2" carried out their cycle of comet studies splendidly at the beginning of March. The comet was studied also by West European and Japanese spacecraft. But the interest in comets naturally has not been exhausted by this initial experiment. Specialists have proposed organizing a flight by an automatic station to a comet in the more distant future, for prolonged study of this heavenly body. The station and the comet would move in direct proximity to each other for approximately three years. Such an experiment presumably could be carried out during the period 1991-1997.

Launches of artificial satellites of the moon and of Venus and Mars, for more extensive studies of the nature of these bodies, are among other projects which are possible in the last decade of this century.

The exchange of opinions regarding promising planet studies was continued at a Soviet-American meeting of planetologists which took place in Moscow late in the summer of 1985. Soviet specialists told their American colleagues about their plans for sending spacecraft to study Mars' moons and for a flight to the asteroid belt.

The "Phobos" project proposes launching two artificial satellites of Mars which will study the composition of Martian rocks by long-distance methods, from an altitude of about 500 kilometers. One of the probes will subsequently be put into a flight path which will enable it to approach Mars' largest moon, Phobos. This spacecraft will practically come to a stop above the surface of Phobos at an altitude of about 100 meters and then move slowly above this body.

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CONFERENCE ON AVIATION AND COSMONAUTICS CONCLUDES

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 19 Mar 86 p 4

[Article by M. Dmitruk, correspondent]

[Text] A conference on the history of aviation and cosmonautics, marking the 25th anniversary of the first manned space flight, is completing its work in Moscow today. Among the participants in this conference are prominent Soviet scientists and cosmonauts, and foreign colleagues of theirs who have taken part in joint missions.

The advancement of orbiting research complexes was the topic of a speech by Doctor of Technical Sciences K. Foektistov, USSR pilot-cosmonaut. Academician O. Gazenko reported on main achievements of medicine in 25 years of manned flights. About 200 people have already been in near-Earth space, and the overall time which they have spent in space has been more than 16 years. Research has shown that prolonged work in orbit does not give rise to irreversible processes in the organism.

Doctor of Physical-Mathematical Sciences A. Galeyev, head of a department of the USSR Academy of Sciences' Institute of Space Research, told about preliminary results of research of Halley's Comet with the Soviet stations "Vega-1" and "Vega-2." Analysis of spectra which were obtained indicate that water, carbon dioxide and organic substances are present in the comet's body, as was predicted by scientists. The presence of a large quantity of iron and other heavy elements was unexpected. Judging from numerous photographs, the comet's nucleus is 7 to 11 kilometers in diameter.

Participants in the conference spoke on international cooperation in the field of manned flight and on the necessity of placing achievements of cosmonautics at the service of all mankind.

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KAZAKH SCIENTISTS URGE CREATION OF REPUBLIC LEVEL REMOTE SENSING ORGANIZATIONS

Alma-Ata KAZAKHSTANSKAYA PRAVDA in Russian 29 Dec 85 p 3

[Article by U. Sultangazin, director of the Institute of Mathematics and Mechanics of the Kazakh SSR Academy of Sciences, member of the academy, chairman of the Cosmonautics Federation of the Kazakh SSR, and V. Drobzhev, director of the Institute of the Ionosphere, doctor of physical-mathematical sciences, deputy chairman of the Cosmonautics Federation of the Kazakh SSR: "Space-Based Resource Study: Why The Development of This New Science is Lagging in Kazakhstan", under the rubric The Tribune of National Discussion]

[Excerpt] Alma-Ata, 29 Dec--Work on remote sensing of earth from space and the use of experimental data on behalf of the national economy is being conducted at many academic and research institutes and a number of ministries and offices.

Our republic has broad opportunities for using space methods of study of the earth's resources in connection with the handling of the Food and Energy Programs, geological and geophysical prospecting, and the need to monitor the condition and pollution of the environment. However, we have not given space-based resource study due attention as a science. Only several of the prerequisites have been created in the republic. At the same time, the demand for intense development of space-based resource study in Kazakhstan is obvious.

For example, geologists urgently require space materials for generalization of geological and geophysical data and identification of a composite geological-geophysical form in the standard mineral sectors for the purpose of developing procedures of integrated study of the mineral-bearing regions of Kazakhstan. The use of space information, along with other geological methods, will likewise enable substantial improvement in the effectiveness of geological prospecting.

The use of space materials in hydrophysics and hydrogeology will promote the development of fundamental research to discover the mechanisms of formation and location of underground waters, appraisal of their resources, and compilation of qualitatively-new hydrological charts reflecting the dynamics of the natural hydrogeological system. Space photographs will offer considerable help in predicting mud flows, landslides, avalanches, and gully erosion.

It is hard to overestimate the prospects opened up by the use of space data in the study of qualitative and quantitative indicators of vegetation, the dynamics of the plant cover and prediction of its changes, and the development of methods of operational monitoring of seasonal and annual changes in the plant cover. The Ministry of Agriculture of the Kazakh SSR is experiencing a special need for such data. From routine primary materials of space surveys, agricultural specialists will be able to observe the condition of young crops, their development and the number of weeds; predict yields; discover sources and the extent of disease and pests of cereals; observe the condition of fodder land, the functioning of reclamation systems, the dynamics of erosion processes and salination of the soil.

In the final analysis, we should be discussing the creation of a permanent service for monitoring or routine patrol of the condition of the harvest from outer space, which is especially critical to Kazakhstan, with its immense areas of cultivation requiring different climatic conditions.

We have given examples of the use of space information in only several areas of science and the economy, but the sphere of their investigation may also be extended to many other sectors of the economy of Kazakhstan.

Certain work in this area is being conducted by the scientists of the Kazakh SSR Academy of Sciences. Thus, the Institute of Mathematics and Mechanics on the basis of a computer center with high-performance computers and a large fleet of minicomputers at its disposal is involved in the adoption of modern methods of computer-aided interpretation of space video information and is analyzing satellite data for the purpose of discovering electromagnetic precursors of earthquakes and study of the natural resources of Kazakhstan. The institute has scientific ties with the computer center of the USSR Academy of Sciences, the Space Research Institute and the Priroda State Center.

The Institute of High Energy Physics has developed a computer input and processing system for half-tone photographs, which has a broad field of application, including the analysis of satellite and airplane photographs.

A receiving station for telemetry information from earth satellites is being built at the Institute of the Ionosphere. True, these purely radiophysical measurements do not concern space-based resource study, and their results are used in sectors associated with radio communications and broadcasting; but the satellite instrumentation of the institute has much in common with the technique of reception and registration of video information. From the results of these studies, the members of the institute together with USSR pilot-cosmonauts V. I. Sevastyanov, A. G. Nikolayev and V. V. Kovalenok have written two monographs.

The Institute of Geological Sciences imeni Satpayev is taking an active part in the integrated research program for utilization of space survey materials to develop the natural resources of the republic. By agreement with the Priroda Center, the Institute of Soil Science as of 1986 will participate in compiling a soil chart for an experimental sector. In future, other institutes of the Kazakh SSR Academy of Sciences also plan to employ space information in their activities.

Several ministries of the republic are also taking space information into their arsenal. However, they receive photographs primarily from the Priroda Center, which results in a considerable delay in using the results in practice. At the same time, the interests of many sectors, especially agriculture, require virtually daily information to allow an efficient monitoring of the harvest in formation and adopt specific measures for rational utilization of plant and water resources. On the other hand, the Priroda Center is primarily involved in solving its own problems which, naturally, differ from those of, e.g., agriculture.

The draft of the Principal Directions of Economic and Social Development of the USSR mentions the need for "more broad and effective use of geophysical and geochemical methods of research, airplane/stratospheric and space resources to study the earth's surface and interior." Such statement of the problem is extremely timely. For the efficient solution of many scientific and economic problems the time has now come to create our own reception and processing center for space information in Kazakhstan, furnished with modern automated systems and instruments for computer interpretation and processing of information, using modern techniques of applied mathematics.

This is a complicated and expensive proposition, requiring close cooperation and joint efforts, since neither the scientific agencies of the Academy of Sciences nor the ministries can deal with the problem separately.

At the first stage, this may be an interbranch center for reception and processing of space information on behalf of the economy of the republic, including such involved organizations as the Kazakh SSR Academy of Sciences, the Ministry of Agriculture, the Ministry of Forestry and the Ministry of Geology of the republic.

Nevertheless, the creation of such center should be regarded as only the first step toward developing space-based resource study in the republic. The next stage may be the organization of a scientific production association (NPO), including institutes, computer centers, special design bureaus and sector-based subdivisions, capable of supporting the operation of such a complicated, multifunctional and multipartite system. In fact, various fields of science and technology are organically interwoven in the investigation of earth resources from space: all the earth sciences, many applications of the physico-technical and mathematical sciences, radioengineering and electronics, precision mechanics, optics and computer technology.

The development of space-based resource study requires not only a fundamentally novel equipment, new mathematical processing methods and new technology, but also an overcoming of persistent stereotypes, conversion to a fundamentally new level of thinking and appropriate training of highly-qualified staff. Only then can we say that the success of the new science will be assured.

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LAUNCH TABLE

LIST OF RECENT SOVIET SPACE LAUNCHES

Moscow TASS in English or Russian various dates

[Summary]

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
13 Mar 86	Soyuz T-15	Commander: Col. Leonid Denisovich Kizim Flt. Eng.: Vladimir Alekseyevich Solovyev			
19 Mar 86	Progress-25	268 km	189 km	88.8 min	51.6°
21 Mar 86	Cosmos-1736	278 km	255 km	89.6 min	65°
25 Mar 86	Cosmos-1737	442 km	230 km	91 min	73°
4 Apr 86	Cosmos-1738	36,560 km	--	24 hrs 37 min	1.4°
		(Carries experimental equipment operating at one centimeter wavelength for relay of telegraph and telephone information; circular orbit)			
9 Apr 86	Cosmos-1739	352 km	182 km	89.5 min	64.9°
15 Apr 86	Cosmos-1740	396 km	208 km	90.2 min	72.9°
18 Apr 86	Cosmos-1741	824 km	784 km	100.8 min	74°
18 Apr 86	Molniya-3	40,664 km	638 km	12 hrs 16 min	62.9°
		(Communications satellite for long-range telephone, telegraph and radio communication and transmission of Central TV to the "Orbita-2" network)			
23 Apr 86	Progress-26	274 km	190 km	88.8 min	51.6°
14 May 86	Cosmos-1742	388 km	209 km	90.1 min	73°
15 May 86	Cosmos-1743	678 km	657 km	97.8 min	82.6°
21 May 86	Soyuz TM	240 km	200 km	88.6 min	51.6°
		(To test performance in autonomous flight and jointly with "Mir" station; developed on basis of "Soyuz T" spacecraft; new systems include approach and docking, radio commo, emergency rescue, new consolidated propulsion unit and new parachute system)			

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
21 May 86	Cosmos-1744	395 km	227 km	90.4 min	62.8°
23 May 86	Cosmos-1745	1,024 km	984 km	104.9 min	83°
24 May 86	Ekran	35,500 km	--	23 hrs 44 min	0.3°
		(TV broadcast satellite with onboard relay equipment for transmission of Central TV programs; near-stationary, circular orbit)			
27 May 86	Meteor-2	974 km	953 km	104.1 min	82.5°
		(Weather satellite with apparatus to obtain global imagery of cloud cover and surface in visible and IR ranges in memory and direct transmission modes; radiometric apparatus for study of penetrating radiation in near-Earth space; data goes to State Scientific Research Center for Study of Natural Resources and USSR Hydromet Center of the State Committee for Hydrometeorology for processing and use)			
28 May 86	Cosmos-1746	308 km	195 km	89.2 min	82.3°
		(To continue study of Earth's natural resources in interests of USSR national economy and international cooperation; data goes to Priroda State Scientific Research and Production Center for processing and use)			
29 May 86	Cosmos-1747	420 km	217 km	90.6 min	70.4°
6 Jun 86	Cosmos-1748-Cosmos-1755	1,506 km	1,444 km	115.1 min	74°
		(Eight satellites launched by single booster)			

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END